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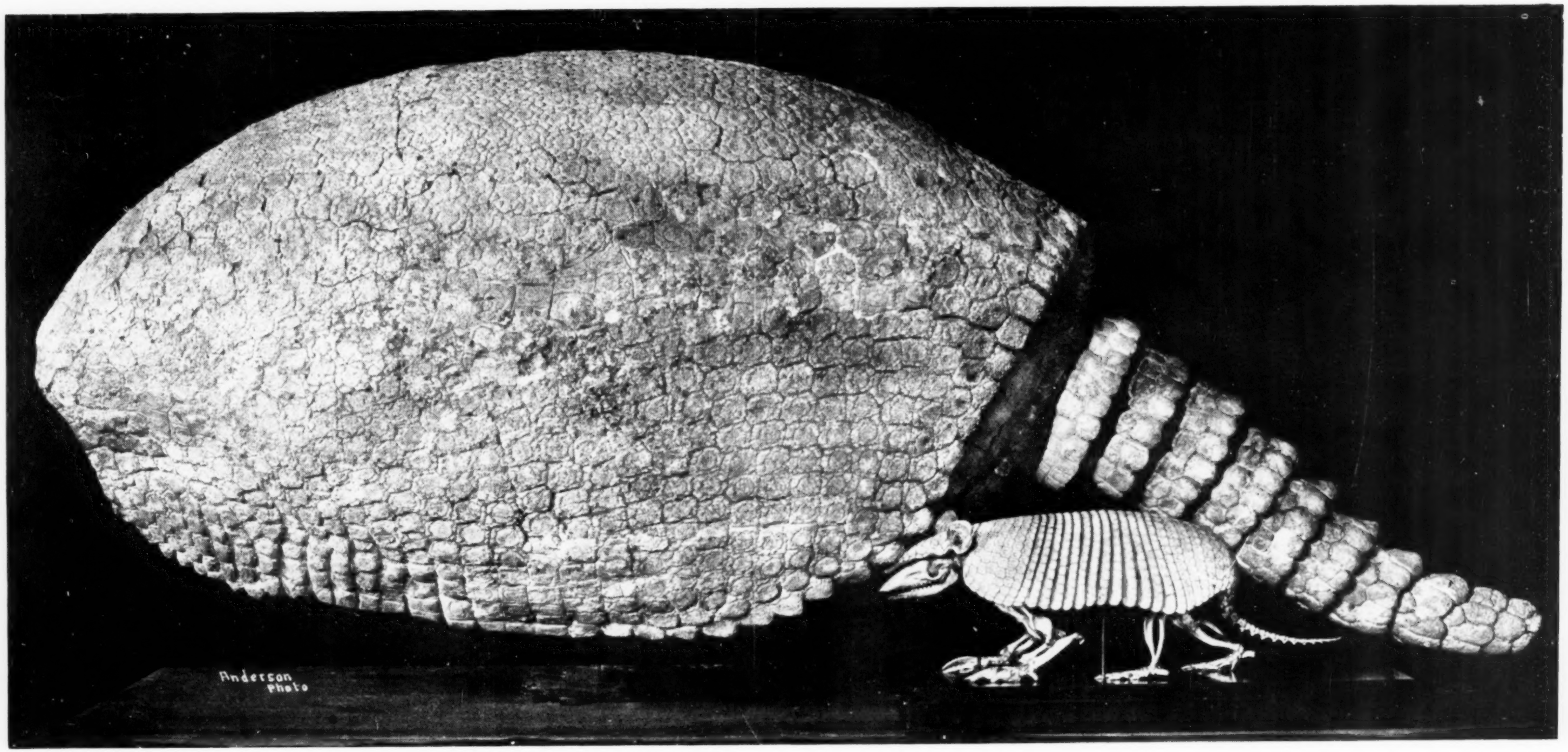


THE ARMADILLO AND ONE OF HIS ANCESTORS

Living armadillos are the representatives of a large family of armored animals of rhinocerine proportions, which flourished in South America in geologic times, thence ranging northward as far as Texas where Henry Fairfield Osborn uncovered the above specimen, a dozen years ago, and named it *Glyptotherium texanum*. It is about 7 feet long, exclusive of the tail. The glyptodonts, as these fossil types are called, may have been immigrants from South Africa, at a time when the disposition of seas and continents was very different from what it is now, but they reached their highest point in size and abundance in the region now occupied by Argentina. Beside the Glyptotherium is the skeleton of a Texas armadillo, its descendant. Photograph from the American Museum of Natural History, New York. (Frontispiece.)

THE BIOLOGY OF TWINS

Light Thrown on Many Interesting Problems by a Study of Twinning—How Twins Are Produced—Critical Experiments in Sex-Determination

TWIN animals represent only the extreme of a process which is found in most living things. In a sense, a man's right hand is the twin of his left hand; or if his body were split in halves from top to bottom, one-half could properly be regarded as the twin of the other. The essence of twinning is therefore "bilateral doubling," which carried nearly to the limit produces Siamese twins, or extended one step farther results in a pair of children who are wholly separated, each one a distinct individual.

The wide range of twinning makes it interesting to every one, and brings in many far-reaching biological problems. H. H. Newman has brought together many of the most important or striking facts in a little book[1] called "The Biology of Twins," in which he considers twins of all kinds in mammals, but particularly the twins of the armadillo, which he thinks furnish "the only key to the mechanics of human twinning."

TWO KINDS OF TWINS

Professor Newman accepts the customary division of twins into two classes. In one case (to which the first paragraph above, refers) two individuals are produced from a single egg. They are, naturally, always of the same sex, and closely resemble each other. They are commonly spoken of as "duplicate" or "identical" twins. In the other case, two individuals are produced from two separate egg-cells, and they are simply ordinary brothers and sisters who happen, so to speak, to develop simultaneously. Whether they will be of the same sex or of opposite sexes is just about an even chance.

The best evidence as to the relative numbers of the two kinds of twins is, in the opinion of Professor Newman, that furnished by the statistics of J. B. Nichols. He found the sex of twins to be distributed as follows, in a large number of cases he collected:

Both males	234,497
Opposite sexes	264,098
Both females	219,312

Roughly, this means for the three classes a ratio of 1:1:1. Since in ordinary births, the sexes are produced in approximately equal numbers, it is evident that, if all twins were nothing more than ordinary brothers and sisters, the ratio ought to be 1:2:1; there would be as many pairs of boys as pairs of girls, and in cases where the twins were of opposite sexes, the number of each sex would be equal.

From this it is concluded that about one-half of the same-sexed twins really stand for only one individual to the pair; they are identical twins. If this reasoning is sound, about one-fourth of all twins born derive from a single fertilized egg cell; the other three-fourths are not "identical" or "duplicate" twins, but ordinary fraternal twins.

HOW TWINS ARE PRODUCED

The development of ordinary twins is sufficiently explained by saying that they result from the simultaneous fertilization and development of two distinct egg-cells. The production of identical twins is more obscure. After an egg-cell is fertilized it splits in two; then each of the halves again divides; and so the division continues almost indefinitely until the whole body is

[1] The Biology of Twins, by Horatio Hackett Newman. Small 12mo, pp. 185. The University of Chicago Science Series. Price, $1.25 net, postage extra. Weight 1 lb. University of Chicago Press, 1917.

formed. It used to be supposed that identical twins resulted when the two halves of the fertilized egg separated after the first division, instead of remaining in contact as they regularly do. But this idea is now considered crude. Newman has to confess that "the problem of the exact origin of duplicate human twins is likely to remain unsolved for a long time to come," but this refers only to the details of the process; there is no doubt that they come from a single egg-cell, in which two centers of growth appear very soon after fertilization.

ARMADILLO TWINS

Some species of armadillo produce duplicate twins regularly at each birth; the species which lives in Texas produces quadruplets by the same process; while a South American species regularly gives birth to eight or even twelve young, all derived from one original egg-cell. The armadillo, therefore, offers excellent material for a study of the process of twinning, and Newman, who has been one of the principal students of it, devotes much space to it in the book under review.

It has been found that for several weeks after the egg of the armadillo has been fertilized, it remains quiescent and undergoes little development. It is this retardation, Newman believes, which results in the establishment of four different growing points, leading to four separate offspring, in place of the ordinary single growing point which would result in a single offspring. But what causes this slowing down? Newman, in 1913, made the rather startling statement that it was due to the presence of a microscopic parasite, probably a protozoan, in the egg-cell. He now feels less confidence in this belief. The parasite may be the cause of retarded development, or merely one of the consequences of it.

THE FREEMARTIN

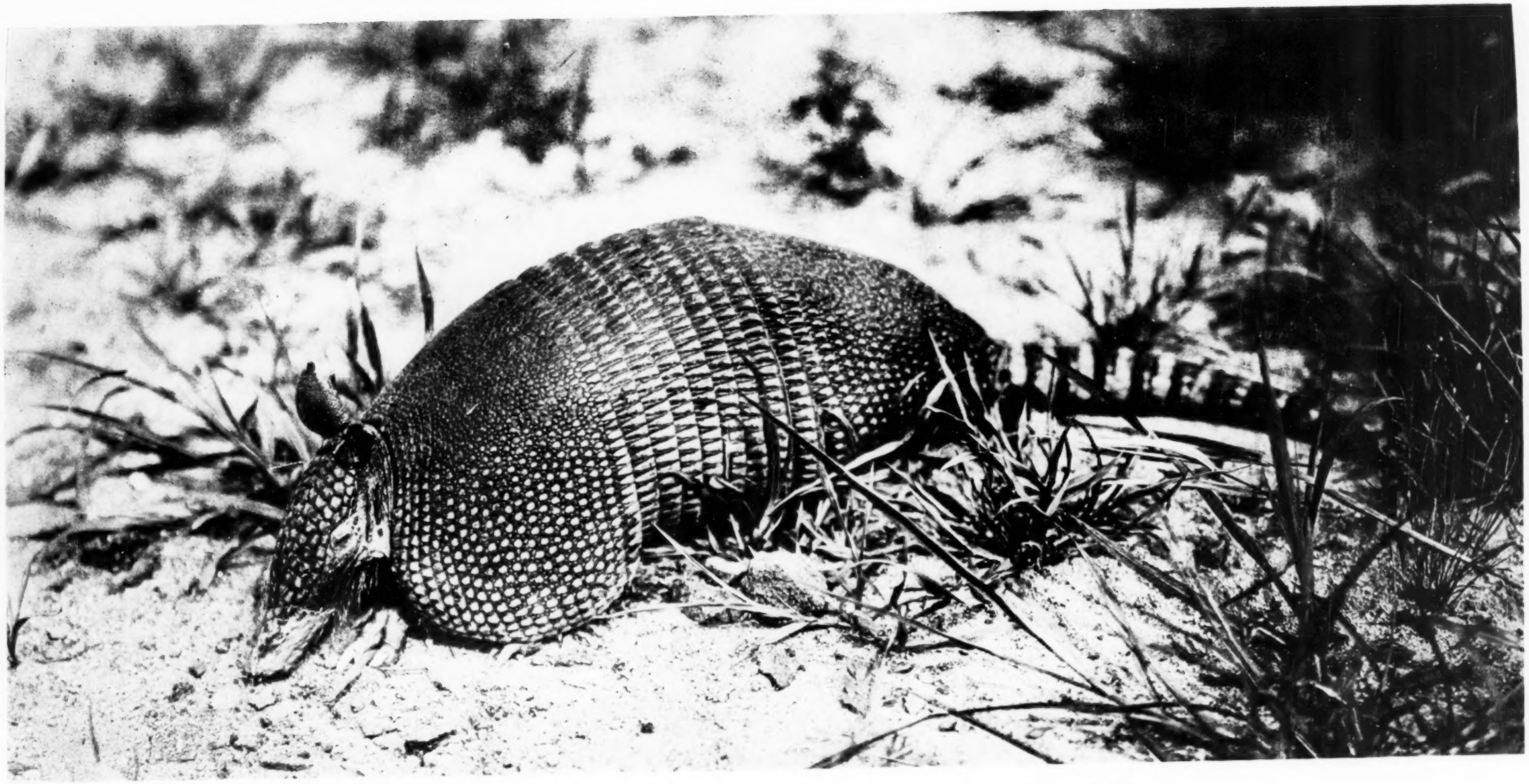
Cattle breeders have long been familiar with a peculiar result of twinning. When a cow gives birth to twin calves of the same sex, they are ordinarily quite normal, but if they are of opposite sexes, the female is sexually imperfect—so much so that until recently it has been supposed that this abnormal twin was really a male. It is called a freemartin, and is always sterile.[2] The mystery of the sterile twin was cleared up recently by F. R. Lillie. Twins in cattle, he found, always result from two separate eggs. At a very early period in development the two embryos lie side by side, partly united, and a constant interchange of blood takes place between them. If both are males or both are females, no harm is done; but if one is a male and the other a female, the reproductive system of the female is largely suppressed, and certain male organs even develop in the female. This is unquestionably to be interpreted as a result of hormone action. The hormones are secretions from the reproductive tissues, which are necessary for the development of the reproductive organs. Probably the hormones of the male become active sooner than those of the female, in the embryonic period. The interchange of fetal blood carries male hormones through the female and prevents the development of the normal female reproductive organs.

Freemartins sometimes occur in sheep, according to W. Bateson, but ordinarily sheep twins are perfectly normal, even if of opposite sexes. Freemartins are not known in other animals.

TWINS AND SEX-DETERMINATION

The problems of sex are today attracting the widest attention, and among these problems that of the mechanism of sex-determination appears to have been largely solved. It appears that in a vast number of animals of all grades of organization, from worms to man, sex is determined at the time of fertilization of the egg-cell. In some forms sex is determined in the egg, for there are two distinct types of eggs, male-producing and female-producing. In other cases the eggs are all alike and produce females if allowed

[2] About one time in eight, a normal female calf is born twin with a male.



THE TEXAS ARMADILLO, WHO IS ALWAYS A QUADRUPLET

The defensive armor of the armadillo is almost perfect, but its purpose is not certain. Its principal use is probably to protect the animal from the thorns that characterize most of the vegetation in which it lives. It also serves to reduce evaporation from the body; but it is not adequate to protect its wearer from mosquitos, who attack at the joints and are the armadillo's greatest enemy. The armadillo lives on ants, grubs, and other insects, and destroys great quantities of cutworms. It would probably pay farmers to extend protection to it. Mexicans and some Americans consider the meat very choice. During recent years the Texas armadillo has been slaughtered in thousands and the shells made into baskets as curios; but the species is said to be increasing rather than decreasing. Photograph by E. R. Sanborn, New York Zoölogical Society. (Fig. 1.)

to develop parthenogenetically (without fertilization), but produce half males and half females if fertilized, the result being due to two kinds of spermatozoa, male-producing and female-producing. In still other cases, notably the hymenoptera (bees, wasps, ants, etc.), males are produced when the eggs are not fertilized and females when the eggs are fertilized. All of these apparently divergent phemonena are consistent with the idea that sex is determined in the germ-cell and that the sex-determining factor is in some way intimately associated with the presence of a peculiar chromosome (the X-chromosome), or group of chromosomes, in the nucleus of the germ-cell. This mechanism gives a sex-bias to the individual, a bias in some cases so strong that no known factors can interfere with the fulfillment of the sex development that was originally determined. In other cases, however, sex may be determined at the time the egg is fertilized, but may require a definite favorable environment to bring it to complete development or differentiation. Finally, in some cases the individual whose sex has been determined as a male, say, in the fertilization of the egg, may have its sex development so altered by outside pressure, as to be almost indistinguishable from a female at maturity.[3]

In mammals there is much evidence that sex is definitely determined at the monent the egg cell is fertilized by the spermatozoön. There appear to be two kinds of spermatozoa and but one kind of egg, and the sex of the individual depends on whether a male-producing or a female-producing spermatozoön fertilizes a particular egg.

If, then, sex in mammals is determined in the undeveloped egg, two or more individuals derived from a single egg would naturally be expected to have the same sex. This is just the point upon which a study of twinning bears, for duplicate twins are, in effect, experiments demonstrating the correctness of the theory of sex-determination which is now held.

If a fertilized egg could be artificially divided into two or more parts, and the individuals developing from these separate parts were always of the same sex, the current theory of sex-determination would be regarded as proved by experiment. The most refined technique is not yet adequate to carry out so crucial an experiment, but nature provides an equivalent one. It has been shown conclusively for two species of armadillo, and by analogy for man, that an egg, divided at an early period, produces individuals all of the same sex. In hundreds of sets of quadruplets of the Texas armadillo there has occurred no exception to this rule, in spite of the fact that in some cases there are marked differences in size of the offspring, due to unequal environment factors. In one case two fetuses of a set are nearly twice the size of the remaining two, yet the sex of all is the same, showing that the sex determined at the moment of fertilization is incapable of alteration through any ordinary change of amount of nutrition and the like.

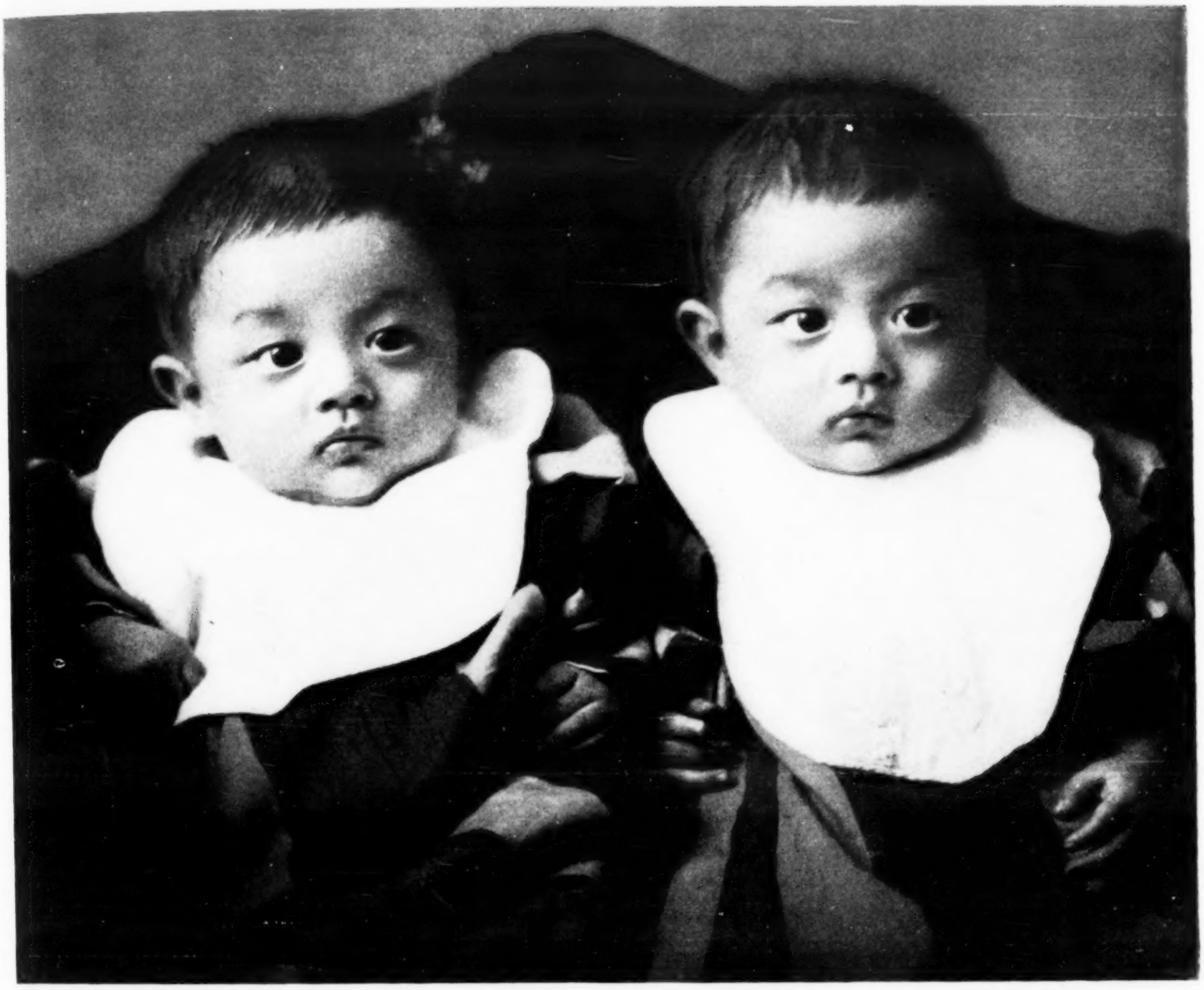
This generalization holds good in other animals than mammals. Litomastix, a parasitic wasp, lays its eggs in the body of a caterpillar, and a single egg divides very early into a large number of parts—as many as a thousand—each of which produces an adult insect. But these adults are always of the same sex.

If then in two groups as far apart as mammals and insects the fact of sex determination at the time of fertilization is proved by twinning, it seems probable that this is a very general principle, possibly almost universal.

SEX-DIFFERENTIATION IN MAMMALS

Although sex is thus determined in mammals, the differentiation of sex-characters depends on a secondary mechanism that is believed to be associated with an internal secretion of the reproductive organs. It has been long known that castration of young mammals prevents the development of adult sexual characters, and the individual re-

[3] For an account of the way this can be done experimentally in pigeons see "Success in Controlling Sex" (an account of the work of Oscar Riddle, and the late C. O. Whitman), in the JOURNAL OF HEREDITY, vii, pp. 158-164, April, 1916.



IDENTICAL TWINS FROM JAPAN

Yeiichi and Yuji Ogata, of Toyko, at the age of 168 days. Yuji, on the right, is only 30 minutes older than his brother. The father of these twins, a member of the American Genetic Association and himself a twin, states that even the parents have difficulty in distinguishing one from the other. There is no record of twins in the mother's ancestry. Such cases as this are commonly believed to lend support to the view that the tendency for identical twinning is transmitted as readily by the male as by the female. (Fig. 2.)

C. H. DANFORTH, St. Louis, Mo.

mains a neuter, although determined as a male. An analogous operation on females produces analogous results. Steinach, in a brillant series of experiments with rats, has shown that a transplantation of ovaries into a young castrated male markedly alters its sex-differentiation, making it take on many characters of the female; even milk glands become functional and a maternal instinct develops. The converse operation on a female tends to masculinize her; she becomes large like the male and exhibits the pugnacious character of the latter. Since only the glandular portion of the transplanted ovary or testis survives in these experiments there is no alternative but to attribute the reversal of sex-tendency to some secretion of these glands, and, for lack of a better term, the active principle has been called *hormone*. These hormones must be given off into the blood, for they affect all parts of the body.

Crucial as are the experiments in transplantation of glands, they do not equal in subtlety and finish the experiment of nature performed in the case of the freemartin. Here an individual genetically determined to be a female may become more or less completely differentiated into a male by the very neat device of borrowing hormone-charged blood from its male co-twin.

These results make it necessary to distinguish most carefully between sex-

determination and sex-differentiation. Sex may be determined genetically by the chromsomes at the time the egg is fertilized, but may be altered more or less completely by a change in the hormones. The chromosome mechanism appears to give a strong initial impulse toward a certain sex, and the hormone mechanism carries this impulse forward to completion. But if the hormone mechanism is reversed, the initial impulse of the chromosomes may be overcome, and the animal which should have become a female will become the equivalent of a male, or *vice versa*.

IS TWINNING HEREDITARY?

In the Texas armadillo it goes without saying that twinning is hereditary; it is the only mode of reproduction in this species. What is really inherited in this case is not fully understood, but it is believed that its basis lies in some physiological peculiarity of the egg, which causes it to have an abnormally slow early development. As noted above, this retardation in the developmental rhythm produces an early fission in the embryonic mass and starts separate development at four different points.

The case is not so clear in other mammals. The experiments of Alexander Graham Bell suggest that twinning is to some extent hereditary in sheep, but other studies have failed to find good evidence of this. All the work that has so far been done on the inheritance of fecundity in mammals has yielded very small results. In man, twinning appears to be hereditary[4] to some extent, and it seems possible that the tendency to produce identical twins may be transmitted through the father as well as the mother. The tendency to produce ordinary fraternal twins is, of course, a function of the mother solely, since it depends on the production of two ova at once. But the details of the inheritance of twinning are extremely obscure.

HEREDITY IN THE ARMADILLO

If the character of an individual were determined wholly by heredity, the armadillo quadruplets ought to be correlated perfectly. As a fact, they are found to be correlated to the extent of about .92. But this is what is to be expected, since room must always be left for irregularities in development. Even a bone in a man's leg is not perfectly correlated with the corresponding bone in his other leg, the coefficient being .97. It is evident, then, that while the pattern of the armor (the particular character studied in this case) is largely determined by heredity, there is some irregularity due to differences in development; but that in the case of these identical quadruplets, heredity[5] is nine-tenths responsible for the individual.

Unemployment and Feeblemindedness

That feeblemindedness is an important factor in unemployment is the conclusion of Glenn R. Johnson, who applied tests to a representative group of 107 unemployed men who applied for charity in Portland, Ore. He considers that about one-fifth of the destitute men in Portland (and probably in other cities on the Pacific Coast) are high-grade morons, and as a group all the destitute men were considerably inferior mentally to an ordinary group of successful men. He found there was no relation between wildness in youth and intelligence, and that extreme dissipation did not seem to affect the intelligence level of some men. His conclusions are reported in the *Journal of Delinquency*, March, 1917. His findings bear out the conclusions of other investigators, that many of the men who are "down and out" are not there because they have never been given a chance, but because they are inherently incapable of utilizing a chance given to them.

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[4] The best concise account is in the JOURNAL OF HEREDITY, vii, pp. 195-202, May, 1916; Is Twinning Hereditary? by C. H. Danforth.

[5] It must be said that Professor Newman's discussion of heredity is not beyond criticism: *e. g.*, the statement (p. 124) that both kinds of twinning in mammals "are characters capable of being inherited as unit characters."

SIGNS OF INTELLIGENCE

Large Head Is Not a Reliable Evidence of Superior Mentality—Conscientiousness More Closely Associated with Intelligence Than Any Other Trait so Far Measured

DANIEL Webster's head was so large that he had to have his hats made to order; and he was a man of great intellectual ability.

On "evidence" of this sort it has been generally supposed that a large head means superior mentality. But this is by no means the only supposed relation between external physical characters and mental qualities. Phrenology tried to build a science on these relations; and after phrenology was transferred by unanimous consent from the realm of science to the realm of superstition, the task of interpreting character by external appearances was taken over by a school, very active during the last few years in the United States, of "character experts." Their work, which has some scientific backing, has been connected rather conspicuously with the movement for vocational guidance and industrial efficiency. They profess to be able, to some extent, to tell by a man's appearance, and especially by an examination of his face and head, what his mental talents are.

There can be no doubt that, in a limited way, character is really revealed by the face. The habitual use of certain sets of muscles leaves lines which register the most frequent emotions of their bearer. But these traits are so subtle and complex that they can hardly be pointed out, much less measured; so far, therefore, they have remained outside the field of exact science.

It is easily possible, however, to decide by exact methods whether there is any connection between a large head and intelligence, because the head can be measured with calipers and the intelligence measured by school standing or estimated by teachers and friends. Similarly a wide range of other characters can be used with precision. In this way large numbers of persons can be studied and the average results found. To cite the case of Daniel Webster as having had a notably large head and great intelligence does not prove that the two are ordinarily found together in men, yet much of the supposed "evidence" cited by those who diagnose character is not worth much more than that.

KARL PEARSON'S STUDY

The problem can never be solved by citing individual instances, no matter how many thousands of them might be collected. But it lends itself admirably to treatment statistically by the correlation method, and Karl Pearson, the master of this method, has done some work on it which seems to deserve being brought to notice, since it was published in technical form[1] and has attracted little attention.

Professor Pearson's subjects were about 1,000 Cambridge University undergraduates (males) and nearly 5,000 English school children, half boys and half girls. The intelligence of each subject was determined by careful methods, based on school standing and teachers' reports, and was correlated with a number of other characters of which either measurements or trustworthy estimates could be made.

Taking first size of head, three measurements were employed: the length, the breadth, and the auricular height, measured from the line of the ear-openings to the top of the skull. In each case there was found to be a slight connection between size and intelligence. But this is so small that

[1] On the relationship of intelligence to size and shape of head, and to other mental and physical characters. By Karl Pearson. *Biometrika*, v, pp. 105–146. London, October, 1906.

there is no possibility of using it to make even rough individual predictions. On the other hand, if a population were divided into those with large and those with small heads, there would probably be a very slight balance of average intelligence in the former group. The length of head is more closely associated with intelligence than is the breadth, and the breadth than the auricular height, but none of these measurements is of any value for individual character determination.

A long series of other tests was then made. "Judging the series as a whole," Professor Pearson says, "it seems impossible to use any of the physical measurements to estimate intelligence from. Hair color is practically as good as head length or breadth, and eye color as good as auricular height, and even all these are more important than the age influence. Health and temper have more relation to the intelligence than any of the physical measurements we have made, while the intelligent child is popular, athletic, and markedly conscientious. Handwriting is doubly as good a test of intelligence as any head measurement."

"Looked at broadly our table seems to justify fully current common-sense methods of estimating intelligence. Give weight to health, temper, physique, popularity, handwriting, and above all conscientiousness, in seeking friend, assistant, or servant, and in doing this you will most probably obtain intelligence also. If you wish to take anthropometric characters into account—and they are not worth much—hair and eye color will be as valuable as head measurements, and you need not produce the calipers in order to observe them!"

After reviewing his studies of school children in detail, Professor Pearson concludes:

THE INTELLIGENT BOY

"To sum up, then: While no characters in school children so far dealt with show very high correlation with intelligence, we may yet say that the intelligent boy is markedly conscientious, is moderately robust, athletic and popular; he tends rather to quick than to sullen temper. He is more self-conconscious and quieter than the dull boy; he has a *slightly* bigger head, and possibly lighter pigmentation than those of more mediocre intelligence. His hair has a larger percentage of curliness.

"The intelligent girl is also markedly conscientious, moderately robust, athletic and popular. She, too, tends to quick rather than sullen temper. She is less self-conscious than the dull girl, and noisier than the girl of mediocre intelligence. It is the slow girl who is quiet and shy. The intelligent girl has a slightly bigger head than the dull girl, and her hair is more likely to be wavy and much less likely to be curly.

"It may possibly be hinted that these results are of little significance, and had they not been so, they could still have been deduced—without elaborate statistics—from the impressions of a careful and observant teacher. It may be so, but much of science is the verification or refutation of opinions and impressions, and the mainly negative conclusions of this paper place at any rate on a sounder quantitative basis the view that even for the mass, and therefore much more for the individual, little can be judged as to intelligence from the more obvious anthropometric measurements and the more easily noted psychical characters of children.

"The onus of proof that other measurements and more subtle psychical observations would lead to more definite results may now, I think, be left to those who *a priori* regard such association as probable. Personally, the result of the present inquiry has convinced me that there is little relationship between the external physical, and the psychical characters in man."

OTHER STUDIES

More recent studies have not required any important modification of Professor Pearson's conclusions. Measurements of the brain itself have failed to reveal any constant relation between size and intelligence.[2] Ameri-

[2] Biometrical Studies of Man. I, Variation and Correlation in Brain Weight. By Raymond Pearl, Ph.D. *Biometrika*, iv, pp. 13–105. London, 1905.

can psychologists who are interested in the question of character analysis have made a few fragmentary studies, and have shown, for instance, that beauty and intelligence tend to go together—as indeed one would expect—but their methods have been much less trustworthy than those of the memoir above quoted, and the results they have secured have not added much to the knowledge of the problem.[3]

It is not meant here to deny that a skilful man can judge character with some degree of success. Very possibly he can, although such accurate tests as have been made have not always been favorable to the claim, according to Hollingworth's account.

Such success as is attained, it would seem, is due to the way in which a man's face frequently reveals his inner nature. His face may be read in an intuitional way; but any claims for the diagnosis of intelligence by means of measurable features of the head have never been substantiated. Much progress in character analysis is to be hoped for from the use of the exact methods of a modern psychologist's laboratory, but it is doubtful whether accurate results can ever be expected from estimates based on external appearances.

PEARSON'S COEFFICIENTS OF THE CORRELATION OF ABILITY WITH VARIOUS MENTAL AND PHYSICAL CHARACTERS

Character	*Mean (both sexes)*	*Boys*	*Girls*
Conscientiousness	.45	.46	.43
Handwriting	.29	.28	.30
Popularity	.26	.22	.30
Athletic power	.22	.20	.24
Temper	.21	.19	.22
Health	.18	.17	.19
Head length	.11	.14	.08
Head breadth	.11	.11	.11
Hair color	.10	.10	.09
Shyness	.10	.03	.18
Selfconsciousness	.07	.10	.03
Eye color	.07	.08	.06
Head height	.06	.07	.05
Age	.06	.05	.08
Quiet habits	.06	.04	.09
Hair set	.06	.04	.09
Cephalic index	...	−.04	.07

Field Workers' Conference on Eugenics

The annual Field Workers' Conference for 1917 will be held at Cold Spring Harbor on Friday, June 22, continuing on Saturday, June 23, at the Brooklyn Institute of Arts and Science. All members of the several training classes in eugenics, as well as other persons who have been engaged in or are especially interested in modern eugenical field studies, are invited to be present.

The plan will be much the same as that of former conferences. There will be no formal program, but each person present will be invited to tell of his or her work during the past year, and to present for discussion some of the problems which have especially presented themselves. Further announcement concerning the conference will be made next month.—*Eugenical News.*

New Tests for Species and Hybrids

External characters have always given naturalists the means of telling one species from another, but the work of E. T. Reichert and others in recent years shows that internal, physical and chemical characters may be used with much precision. Dr. Reichert describes the continuation of his work in the yearbook of the Carnegie Institution. Many different tests have been made of starches, and it is found that those from one species react differently, in many ways, from those of even a closely related species. Genus and variety also yield distinctive results while hybrids may, by the new methods, be referred to their true parentage. Similar studies are being made of proteins.

[3] Prof. H. L. Hollingworth's book, "Vocationa :Psychology" (New York, 1916), gives a good summary of the work that has been done.

BREEDING SOUTHERN GRAPES

Scuppernong and Other Rotundifolia Varieties Offer Promise of Large Returns to the Breeder—Technique of Cross-Pollination—Characters That Should Be Improved

L. R. DETJEN
Agricultural Experiment Station, West Raleigh, N. C.

IN MANY of the South Atlantic States, excellent grapes of the species *Vitis rotundifolia* grow wild in profusion. They were brought under cultivation as early as the first half of the eighteenth century, when tradition says that a particularly good vine found on the wooded bank of Albemarle Sound was domesticated and given the name of Scuppernong. This variety is still the most important and most widely disseminated, a fact which shows that very little systematic improvement of the species has been made, although one variety or another is now to be found in almost every garden along the coast of the Carolinas. Within recent years the great potential value of the rotundifolia grapes has been recognized and their improvement attempted.

Improvement of the grape may follow along several distinct lines. As a wine grape (for which the rotundifolia species has been much used) one set of characters must be selected and intensified; as a table grape other characters must be accumulated and improved, or entirely new ones introduced from another species. Since the wine industry in this country has been demoralized by the prohibition movement, the greatest opportunity of improvement among rotundifolia grapes today lies in the production of a superior table grape. The Scuppernong, as is well-known, together with its kindred varieties in the red and in the black colors, although possessing high qualities and flavors, is decidedly deficient in such characters as are intimately associated with a dessert grape. For example none of the varieties of rotundifolia grapes can be called a bunch grape and none of the better varieties even produces berries that adhere to the stem. This means that the skins at the point of contact are usually broken, micro-organisms make themselves at home in the exuding juices, and the grapes soon begin to sour. Even if the utmost precaution is taken not to break the berry skins the natural sprightly flavor in the fresh fruit of most varieties disappears soon after picking, leaving the fruit less palatable. If we add to all of this the extreme thickness of the berry skins, the very large seeds, and a very high acid content of the pulp we begin to realize the need for improvement in this group of grapes.

Permanent improvement in this species might be attained in two distinct ways: first, by inter-crossing desirable varieties within the species; second, by the out-crossing of desirable varieties with selected vines from without the species.

GREAT VARIABILITY

A survey of the material that has been secured in the way of varieties and seedlings indicates that it may not be necessary to go outside of the species for improvement, but that in due time the patient and persistent plant breeder will succeed in producing a grape worthy of taking its place among the best table varieties.

Although the rotundifolia species with its many undesirable qualities is considered by many persons as very stable, this conception is altogether erroneous, because the species has been found not only to include almost all of the characters that can be desired, but to have them in wide range, so that it will yield great results in the skilled hands of the plant breeder. For instance, the variety Scuppernong generally produces its fruits in clusters of from two to six

THE USUAL DEFECT OF ROTUNDIFOLIA GRAPES

While the species has many excellencies, it also has many drawbacks, one of the most conspicuous being that the clusters are very small. Another is that the berry usually falls from its stem when picked; that is, the clusters shatter. The first object of breeders is to remedy these two defects, which in the past have made the species useful only for the manufacture of wine. (Fig. 3.)

berries, small clusters being the rule. By careful selection of parent vines seedlings have been obtained that generally produce bunches of from ten to twelve berries. Exceptional clusters have been found on rotundifolia vines consisting of from twenty-seven to thirty-three and thirty-five berries; these, however, are quite unusual. By judicious crossing and stringent selection the clusters no doubt can be increased in size so as to include a much larger number of berries until a vine is produced that will rank second to none of the native grapes with respect to size of cluster.

Another instance of variability is the bloom or waxy coat on the surface of the fruit. The berries of the Scuppernong and of other rotundifolia varieties are devoid of the heavy bloom generally so conspicuous on table grapes. Some seedlings of this species, however, have produced a coat of bloom that would do real credit to almost any dessert grape. Again, generally speaking the fruit of

A PROMISING VARIETY FOR THE GRAPE BREEDER

The clusters of Luola, above shown, are really respectable in size, and it also has a fairly good flavor. As rotundifolia grapes are admirably adapted to the section in which they grow wild, it is believed that the production of a few superior varieties will ensure a very large industry in the Carolinas and neighboring States. (Fig. 4.)

Vitis rotundifolia drops from the vine as soon as it ripens. There are some vines, however, whose fruit clings more tenaciously to the pedicels than many a grape of the so-called bunching varieties. In this case it again is simply a matter of transmitting this character by careful crossing to the desired seedling vines.

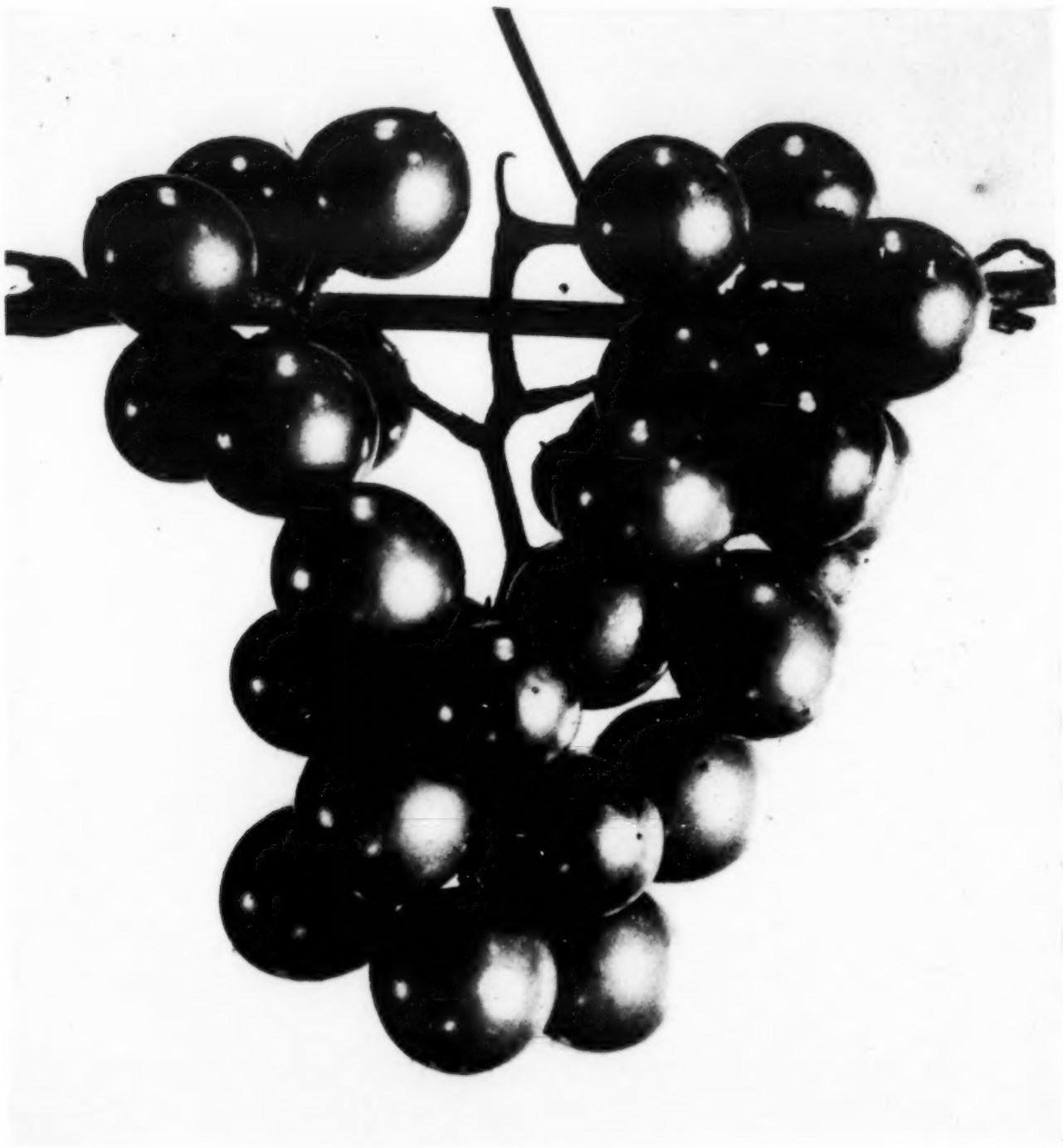
In this same way all of the many other desirable characters from other varieties but of the same species can be assembled, or corralled as it were, the undesirable ones eliminated, and the resultant seedling would still be a rotundifolia grape vine true to type.

The out-crossing method for the improvement of this group of grapes consists essentially of the crossing of selected vines with those of a related species, thereby introducing characters that are foreign to the group. This is often a more rapid method for securing improvement but to the breeder the identity of the species is thereby lost either in part or altogether. The general public, however, cares little about such fine points in methods of achievement and is interested only in the final product, a good table grape.

TECHNIQUE IN CROSSING

The reader, it is presumed, is sufficiently informed as to the methods that are generally used in the crossing of flowers, therefore I shall dwell chiefly on points which may be a departure from the general rule and which might be applicable specifically to *Vitis rotundifolia*.

Grape pollen may be gathered and handled in several different ways. One method that was found to be very convenient is the following. Pollen material is best collected in the morning hours, between 7 and 9 o'clock, because at this time of day very few if any of the



A GOOD CLUSTER OF SANMONTA

Rotundifolia grapes are normally pollinated by insects, the pollen being too heavy and sticky to be carried by the wind. Whether the crop is good depends to a large extent on whether enough insects have been working in the vineyard. In this case a bunch of flowers was bagged, and a bee (family Andrenidae) put in the bag. The efficiency of his work is evident. Photograph natural size. (Fig. 5.)

flower buds have opened and scattered their pollen. Material that is collected on the preceding day is generally not matured enough to go through the regular process of liberating the pollen and difficulty may be experienced in its extraction. Flower clusters with mature buds, and mainly such as will bloom during the same day, are selected and gathered in quantities large enough to insure a sufficient amount of pollen. This material is thoroughly rinsed with clean water to remove or destroy all adhering foreign pollen, hastily dried by removing the excess water either by swinging the material sharply in the air or with the aid of blotting paper, and immediately placed in suitably labeled paper trays. These trays are lightly covered with a piece of clean paper, placed in a dry but airy room, and the buds are allowed to open up naturally, which they will do within a comparatively short time. By noon all of the mature buds will have opened but the contents of the trays are not removed until the following day when the plant material will be sufficiently dry so that the pollen can be extracted.

The process of separating the pollen from the dried flowers is a very simple operation. All that is required is (1) a glass test-tube into which a conveniently small amount of the dried material is placed and shaken. By jarring or gently tapping the tube the fine dry pollen will sift down to the bottom from whence it can be trans-

ferred by means of (2) a small camel's hair brush into (3) a small clean glass vial. After a sufficient amount of pollen is thus secured the vial is lightly stoppered and labeled so that its identity will not be lost when placed among other but similar vials previous to pollination.

Should pollen-bearing flowers for any reason not be plentiful a different method of procedure may be resorted to. The flower buds are gathered, washed, and allowed to open and cure in the paper trays according to the usual methods, but the pollen, instead of being shaken from the dried anthers, is transferred together with them from the paper tray direct to the small receiving vial. Instead of using a camel's hair brush for this transfer a clean forceps is preferred, because the waxy grape pollen is sufficiently adhesive to cause the entanglement of large numbers of the grains with the dried cluster material and with the fine hairs of the brush, thus incurring a great loss of pollen. This waste may be prevented by the use of a clean, fine pointed, steel forceps to which only a comparatively small amount of pollen adheres, and by not shaking the pollen from the anthers but keeping it confined until it is to be applied to the pistils of the female vine.

FRESH POLLEN NEEDED

Rotundifolia grape pollen ought to be used preferably on the same day or the following day after it has been gathered, but in case of necessity can be stored a few days longer. In ordinary room temperature it begins to deteriorate rapidly after it is forty-eight hours old, and not infrequently earlier, hence it is best not to prepare the pollen sooner than twenty-four or thirty hours previous to the time of pollination.

While the pollen is being gathered and cured the flowers of the female parent vine should be prepared for cross-pollination. This can be done by either of two methods, all depending on the nature of such flowers: (1) If these flowers bear the reflexed type of stamen we know that they are self-sterile and also inter-sterile.[1] Being thus affected with sterility they need not have their stamens and pollen removed previous to crossing with other varieties. This knowledge is of the highest importance because by its application much time and labor can be saved to the grape breeder. All that is necessary then to prepare such imperfect hemaphrodite grape flower buds for the event of crossing is simply to inclose them in bags before any of them can open and thereby expose their receptive pistils. (2) If the grape flowers bear upright stamens we know that they are self-fertile and the method of preparing such flowers for cross-pollination is the one that is usually adopted by plant breeders of emasculating the flower buds previous to bagging and pollination. This can be done very conveniently by operating on fully matured buds in the afternoon, thirty-six hours previous to the application of pollen to the prepared pistils. A slight pressure firmly applied above the middle of the bud with a pointed forceps will usually cause the cap and also the inclosed stamens to become detached from the receptacle and leave the pistil bare. When all of the mature buds on the cluster have been thus treated they are thoroughly rinsed or dipped in clean water to wash off and destroy all adhering pollen, if there be any, that might have been discharged by an anther bursting during the emasculating operation. If this precaution is not strictly observed many of the flowers will become self-fertilized and perplexing results might be obtained. The prepared flower clusters are now inclosed within light paper or cloth bags to await the process of artificial hand pollination.

The methods of transferring pollen to the pistils of the bagged flowers are several and choice depends mainly on the amount of available pollen. When this is plentiful the work can be materially hastened by the use of a small camel's hair brush; when it is not so abundant as one might wish, the thumb nail method or the anther and forceps

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[1] North Carolina Agricultural Experiment Station Bulletin No. 209.

READY FOR POLLINATION

In the upper part of the photograph are shown three baskets of flower-buds which, after being washed, have opened out and are ready to shed their pollen. Below are three glass vials with camel's hair brushes and some pollen ready to be used in cross-pollination. (Fig. 6.)

may be resorted to. In the former case the brush is used to expedite the actual crossing of the flowers, while in the latter cases economy of pollen determines the method.

When all of the flowers are cross-pollinated the bags are replaced and, if these happen to be made of a thin fabric, are left on the vine until the resulting fruit, if any develops, can be harvested.

STARTING THE SEEDLINGS

Grape seedlings may be started in various ways. The one-seed-to-one-pot method, when used in a greenhouse, becomes too expensive because the pots take up too much space; when used out of doors it is unsatisfactory because uniform conditions of moisture are difficult to maintain.

When greenhouse facilities are available, seeds which have been stratified, should be drilled about one-half inch deep in flats filled with a good, light, greenhouse soil. If no such facilities are available then the seedlings may be started in a similar soil but planted direct in a glass-covered cold-frame. Probably the only advantage obtained by starting the seedlings in a greenhouse is earliness. This method is especially recommended for seeds which have been obtained from flowers that were self-pollinated, because the resulting plants from such seeds are apt to lack vigor.

After the plants have attained a height of 3 or 4 inches they can be set out into nursery rows, in very much the same manner as cabbage plants are and without any serious setback. It is best, however, to shade the newly trans-

planted seedlings during the three following days by covering them with 3-inch flower pots during the daytime. These pots not only provide shade but also prevent rapid transpiration which is so fatal to newly set plants.

Rotundifolia grape seedlings, unlike other grapes, should be trained beginning with the first season by the process of disbudding all lateral growth. When the plants are 1½ feet tall they should be loosely tied to the lower wire of a trellis and as they grow taller they are tied to successive wires higher up. During the second year side branches are allowed to develop and the height of the plant is determined only by the height of the upper wire of the trellis. By the third year the plants, if well grown, should begin to bear fruit.

The study of the seedling vines really commences in the seed-bed and with the majority of them may be concluded in the nursery row. Most of the vine and fruit characters can be secured from the plants while they are growing in the nursery rows. Should the work of the breeder be centered mainly on the clusters and fruits, then the seedlings ought to be given more space for the perfect development of the whole plant.

The Selection of Naval Officers

That naval officers for the present war should be selected partly on their heredity and juvenile promise was the contention of Dr. Charles B. Davenport, of the Carnegie Institution's Department of Experimental Evolution, who addressed the National Academy of Sciences in Washington on April 17. Considering only the "fighting type" of sea captain like Nelson, Cushing, Farragut and Dewey, as distinguished from the exploring, inventive and diplomatic types, he found the following traits usually present in boyhood: (1) love of the sea; (2) nomadism, particularly marked in such a man as John Paul Jones; (3) hyperkinesis, an aggressive, restless temperament; (4) an adventurous disposition and absence of fear; (5) ability to command men. He believed that it would not be difficult to get the necessary data about young men who apply for commissions in the navy, and that selection of them from a eugenic point of view would aid greatly to secure an able body of men.

Delinquency in City and Country

There is a widespread idea that crime and delinquency are particularly problems of densely populated areas. J. Harold Williams has tested this idea by a careful investigation in Southern California (*Journal of Delinquency*, March, 1917). He finds (1) that delinquency is more prevalent in small towns, and rarest in the open rural country; (2) that no particular kinds of offenses committed by delinquent boys are especially associated with city, town, or rural population; (3) that the average level of intelligence is higher in delinquent boys from the cities than in those from the towns and rural districts. The proportion of feebleminded-ness is greatest in rural districts.

Dr. Salmon Appointed on Immigration Committee

To fill a vacancy, Dr. Thomas W. Salmon has been appointed a member of the American Genetic Association's committee on immigration, of which Prescott F. Hall, of Boston, is chairman, and Prof. Robert De C. Ward, of Harvard University, is secretary. Dr. Salmon was formerly connected with the U. S. Public Health Service at Ellis Island, and is now medical director of the National Committee for Mental Hygiene.

THE CELIBACY OF TEACHERS

WHETHER women are more efficient teachers than men, and whether single women are more efficient teachers than married women, are disputed questions which it is not proposed here to consider. Accepting the present fact, that most of the school teachers in the United States are unmarried women, it is proper to examine the eugenic consequences of this fact.

The withdrawal of this large body of women from the career of motherhood into a celibate career is desirable if the women are below the average of the rest of the women of the population in eugenic quality. But it would hardly be possible to find enough eugenic inferiors to fill the ranks of teachers, without getting those who are inferior in actual ability, in patent as well as latent traits. And the idea of placing education in the hands of such inferior persons is not to be considered.

It is, therefore, inevitable that the teachers are, on the whole, superior persons, eugenically as well as personally. Their celibacy must be considered highly detrimental to racial welfare.

But, it may be said, there is a considerable number of women so deficient in sex feeling or emotional equipment that they are certain never to marry; they are, nevertheless, persons of intellectual ability. Let them be the school teachers.

This solution is, however, not acceptable. Many women of the character described undoubtedly exist, but they are better placed in some other occupation. It is wholly undesirable that children should be reared under a neuter influence, which is possibly too common already in education.

If women are to teach, then, it must be concluded that on eugenic grounds preference should be given to married teachers, rather than single ones, and that the single ones should be encouraged to marry. This requires (1) that considerable changes be made in the higher education of young women, so that they shall be fitted for motherhood rather than for nothing except school teaching, and (2) that social devices be brought into play to aid them in mating —since it cannot be doubted that a large proportion of celibate school teachers are single from necessity, not from choice, their profession not being favorable to finding mates.

It is, perhaps, unnecessary to mention a third change necessary: that school boards must be brought to see the undesirability of employing only unmarried women, and discharging them, no matter how efficient, if they marry or have children; and that the courts must be enabled to uphold woman's right of marriage and motherhood, instead of, as at present, upholding school boards in their denial of this right.

Against the proposal to employ married school teachers, two objections will at once be urged. It will be said (1) that for most women school teaching is merely a temporary occupation, which they take up to pass the few years until they shall have married. To this it may be replied that the hope of marriage too often proves illusory to the young woman who enters on the pedagogical career, because of the lack of opportunities to meet men, and because the nature of her work is not such as to increase her attractiveness to men, nor her fitness for home-making. Pedagogy is too often a sterilizing institution, which takes young women who desire to marry and deprives them of the possibility of marriage.

Again it will be said (2) that married teachers would lose too much time from their work; that their primary interests would be in their own homes instead of in the school; that they could not teach school without neglecting their own children. These objections fall in the realm of education, not eugenics, and it can only be said here that the reasons must be extraordinarily cogent, which

will justify the enforced celibacy of so large a body of superior young women as is now engaged in school teaching.

The magnitude of the problem is not always realized. In 1914 the commissioner of education reported that there were, in the United States, 169,029 men and 537,123 women engaged in teaching. Not less than half a million women, therefore, are potentially affected by the institution of pedagogical celibacy—an institution which is to be compared with that of sacerdotal celibacy in the amount of permanent harm that it is capable of doing to the race.

The Status of the Presence and Absence Hypothesis

To explain the inheritance of genetic differences, we assume the presence in each germ-cell either of one of two alternative factors (Morgan and his school), or the presence or absence of one unpaired factor (Bateson and his followers). Bateson's "presence and absence hypothesis" applies to Mendelian character differences if they are quantitative, and is extended to the genetic differences in the germ-cells, whether these result quantitatively or qualitatively. It demands, I think, the following subsidiary hypotheses:

1. That even qualitative differences are due to presence and absence, and not to substitution of factors.
2. That dominance (or prevalence) is always the mark of the presence of a factor.
3. That recessive factors do not exist.
4. That even where dominance or prevalence is absent, the side on which the factor is present can safely be guessed at.
5. That all cases of multiple allelomorphs (triangles of Baur) are due to complete linkage.
6. That double presence of a dominant (or prevalent) factor is often more effective than its single presence.

To infer the nature of the germinal factors from the results of their operation is not usually possible in such complicated biochemical machines as plants and animals. Hence the comparative simplicity of the presence and absence hypothesis is, I think, illusory. In working with a quantitative Mendelian difference it is permissible, as a mathematical convention, to regard the result of one factor as zero;[1] but this does not apply to qualitative differences.

1. The two-factor hypothesis escapes the speculation that the dominance or prevalence of a "character" informs us as to the nature of the germinal factor causing it.
2. The two-factor hypothesis applies equally to qualitative differences: *e.g.*, peloric and regular flowers.
3. The two-factor hypothesis is confirmed by every case of multiple allelomorphs discovered.
4. Fluctuation of dominance and absence of dominance are, I think, more readily intelligible on this hypothesis.
5. Few or no subsidiary hypotheses are needed.
6. Dominant mutations, which are a stumbling-block to users of the one-factor hypothesis, agree about as well as recessive mutations with the two-factor hypothesis.

As Morgan and Sturtevant have already shown, the two-factor hypothesis can be used in Mendelian work as well as or better than the presence and absence hypothesis. But in various cases both may be true.

JOHN BELLING.

A New Strain of Hybrid Sheep

A strain of Hampshiredown-Rambouillet hybrid sheep has been almost perfected at the New Hampshire Experiment Station, according to Dr. Charles B. Davenport, who started it. The new breed is said to show in a high degree a union of especially valuable qualities of fine wool and good conformation. A second hybrid generation of a Southdown-Rambouillet cross has been produced.

[1] See "Inheritance of Length of Pod," by John Belling, in *Journal of Agricultural Research*, December, 1915.

BRAINS AND SOCIAL STATUS

Children of Professional and Upper Commercial Classes Found to be the Most Intelligent—Possible Reasons

ARE there considerable differences in natural intelligence between the various social classes of the population? If so, where is the most mental ability found? Do the children of traveling salesmen, for instance, stand above or below those of lawyers? Do the boys of the poorer classes, who roam the streets, really secure that sharpening of the wits which is sometimes credited to them, or are they actually inferior in intelligence to the children of the well-to-do middle classes, who are carefully kept at home?

All these and similar questions are of importance in many ways, and in recent years a beginning has been made at answering them, in a number of psychological researches where mental tests have been used, of a kind that are believed to measure the real mental ability, and not merely the results of formal education.

1. A suggestive contribution is that of F. Umberto Saffiotti and his associates of the Laboratory of Pure and Applied Psychology at Milan, Italy.[1] Mental tests were given to the pupils in four elementary schools, a modified form of the Binet scale being used. Information was also secured as to the social and economic status of the parents of the children, and six groups of fathers were made, as follows:

A. Professional (including higher officials, lawyers, doctors, engineers, accountants, artists, magistrates, officers, professors, etc.).

B. Upper commercial (merchants, managing directors, people of independent means, etc.).

C. Lower commercial (agents, representatives, commercial travelers, inferior and private officials and employes, superior skilled labor such as electricians, mechanics and engravers).

D. Tradespeople (vendors, innkeepers, butchers, grocers, milkmen, druggists, etc.).

E. Artisans (including mechanics and manual laborers, smiths, carpenters, bricklayers, shoemakers, hairdressers, etc.).

F. Servants (domestic employes, shop assistants, porters, commissionaires, etc.).

The children were then classified in three groups, according as the mental tests and, apparently, the school standing showed them to be dull, mediocre, or bright. They were further classified according to their parents' occupations. The results from the first grade only will be cited here; they are as follows:

MENTALITY OF CHILDREN FROM VARIOUS SOCIAL CLASSES

Social group	*No. tested*	*Dull*	*Mediocre*	*Bright*
A. Professional	37	16.2%	32.4%	51 3%
B. Upper commercial	35	22.8	22.8	54 2
C. Lower commercial	71	26.8	29.6	43.7
D. Tradespeople	35	40 0	40.0	20 0
E. Artisans	144	38.9	26.4	34 7
F. Servants	56	30.3	33.9	35.7

The figures are small, but Saffiotti believes the children represent fair samples of their social groups. In mentality, the three upper classes form a somewhat sharply defined group, set off from the lower ones by a well-

[1] Saffiotti, F. Umberto. Contributo allo Studio dei Rapporti tra l'Intelligenza e i Fattori Biologico-sociali. Rivista di Antropologia, xviii, fasc. 1, 2, Roma, 1913. The account herewith presented is taken from one by Cyril Burt in the *Eugenics Review*, pp. 365–373, London, January, 1917.

THE STREET AS A KINDERGARTEN

Popular opinion believes that the children of the poorer classes in large cities acquire a certain amount of valuable education by runn'ng on the streets. Actual tests usually indicate, however, that such children stand very low in all the higher forms of intelligence; and this might have been suspected from an examination of the environment in which they are brought up. Association with older people is one of the most important factors in a child's education; but in the poorer classes the dwellings are so small that a child must spend most of his waking hours outside, and nowhere does he come in close contact with many older persons of ability. Photograph by Milton Fairchild. (Fig. 7.)

marked line. The professional group yields the fewest dullards and the trading class the most. The upper commercial group yields the largest proportion of bright children, but the professional group is not far behind. The trading class shows the highest level of mediocrity, and a little distance behind it, the servant and professional class stand on almost even terms.

Single indices of ability were worked out for the six classes, which show that the professional is easily the highest and the trading class the lowest, as represented in these Milan school children:

Professional	51.9
Upper commercial	50.8
Lower commercial	47.2
Servants	44.4
Artisans	41.7
Tradespeople	38.1

This ranking is not wholly what many would expect, and Saffiotti briefly discusses the causes of it, seeming inclined to give more weight to the non-hereditary than to the hereditary factors. He points to the intellectual interests and occupations that constitute the daily life of the professional classes, the intelligent but specialized outlook of the upper commercial and manufacturing classes, to which should be added the stimulus of keen competition; and the comfortable economic circumstances of the lower commercial class, with labor of a character that is somewhat favorable to the development of intelligence. In all these cases, he thinks, the environment is such as to produce bright children. For the relatively high standing of the children of the servant class, he seeks an explanation in

AN ENVIRONMENT FOR MENTAL STARVATION

No matter how much one may admire the development of modern industrial society, he can hardly believe that it offers a full and rich environment in which a child may "unfold," under such circumstances as are shown above. Even if a child had inherited ability (and many of the children who roam the streets have not) it could hardly be called into full play by the stimulus of a modern city street, which, compared with the country, offers little for a child to do. Much has been said of the evils of child labor, but under modern city conditions it is conceivable that child idleness may sometimes be equally injurious. Photograph by Milton Fairchild. (Fig. 8.)

the fact that they are in personal contact with people of a superior status and culture. The low standing of the offspring of tradespeople he attributes to "the constant contact with pettiness and poverty, the free roaming of the street and the uncontrolled participation in its gossip, license and freedom, the neglect of child welfare and of proper supervision and, frequently, the imitation of a bad example."

To many persons, these explanations will not be altogether convincing. It will seem more satisfactory to recognize more fully the differences in inherited intelligence. But Saffiotti's material is not sufficient to settle the problem nor will any of the other studies here cited settle it.

2. At a school attended by the children of the rich in Brussels, Decroly and Degand found that the children were on the average a year and a half superior to the standard of their age, in

THE CITY TEACHES SELF-RELIANCE

It is very likely that the street gamin may be more self reliant, more assertive, more capable of looking after himself in some kinds of difficult positions, than a boy who has been more carefully nurtured. Such real benefit as life in the streets confers is mostly of this sort—a very different thing from real intellectual capacity. Parents who want their children to be well educated ought to provide them with such opportunities for developing self reliance and initiative as the boys of the streets have, but give them mental training of a more valuable kind at the same time. Photograph by Milton Fairchild. (Fig. 9.)

intelligence. Binet himself reviewed[2] these results, and concluded that they were due to a relation between intelligence and social status. He continues:

"There is a whole series of tests in which the advance is more marked than the others; and consequently, it is perhaps possible to deduce something interesting upon which aptitudes are most favored in the education of a rich child. *A priori* one would suppose that these children, little used to serving themselves, constantly surrounded by willing servants, would be more awkward with their hands than future workmen. But without making suppositions let us see what the facts reveal."

As a fact, these children were found to have done particularly well in arranging a series of weights in accordance with their real value. On the whole, Binet decided that their superiority was in those traits in which proficiency was favored either by attention (3 tests), home training (4 tests) or language (6 tests); the last point was the most conspicuous, the children of the upper classes being able to understand and to express themselves more readily than the average at an early age.

3. Morlé studied thirty children from one of the poorest schools in Paris, and an equal number from a wealthy school,[3] and found a difference of ¾ year, on the average, between the intellectual standing of pupils of the same chrono-

[2] Binet, Alfred. The Development of Intelligence in Children, pp. 316–322. Vineland Training School, 1916.

[3] Binet, *op. cit.*, pp. 326–328.

LEARNING HOW TO GET ALONG WITH OTHERS

The boy of the city streets becomes a "good mixer," and this probably makes him appear to have greater ability than he really possesses. Psychological tests have almost uniformly shown him to have less real intelligence than boys of the class who are kept more closely at home. It is, therefore, necessary to suppose that boys of the street have either been brought up in conditions which were unfavorable to the development of intelligence, or have failed to inherit good intelligence. There is unquestionably some truth in both of these ideas. Photograph by Milton Fairchild. (Fig. 10.)

logical age. Of the thirty wealthy pupils, sixteen were ahead of their age, while only five in the poorer school were advanced. The better group showed four backward children, the poorer group twelve.

A GERMAN INVESTIGATION

4. Teachers in the Breslau (Germany) schools compared pupils in the Volkschule, attended by the poorer classes, and the Vorschule, whose pupils come from the ranks of the well-to-do.[4] The 9-year-old boys in the former were, in intelligence, 10% inferior to boys of the same age in the latter, while ten-year-old boys in the poorer school were equal only to 9-year-old boys in the richer school. It was suggested that children of the higher social classes mature earlier.

5. Three groups of pupils, each containing about seventy individuals of both sexes and the same age, were compared by J. and R. Weintrob. Group A belonged to the wealthy class,

[4] This and the two following studies are taken from a review by Bridges and Coler in the *Psych. Rev.*, January, 1917.

had had the advantage of travel, etc.; the fathers of this group were nearly all American. Group B was mostly of German and Italian parentage; the fathers were wage-earners or small business men. Group C was made up of the children of a Hebrew Orphan Asylum who had had, strictly speaking, no home environment. In the various tests of intelligence group A was first but the Hebrew orphans of Group C were a close second. Group B was last. The investigators say, "Judging from the results environment does not seem to affect greatly mental capacity, if at all." If that is true, then the differences of intelligence of the children must be due to inherited differences, partly racial, in the various social classes.

6. Children (all white) in the city schools and in the schools of the mill district in Columbia, S. C., were tested by Miss A. C. Strong. Approximately the same course of study was presented in both schools. None of the mill children was above his age level, but 10% of the city children were. Less than 6% of the city children, but 18% of the mill children, were retarded at least one year.

7. Yerkes and Anderson tested fifty-four children in the kindergarten and first grade of a "favored" Cambridge (Mass.) school and an equal number from a school whose children had a much lower economic and social status.[5] They found that at and about the age of six years, the "favored" children did from a quarter to a third better in the tests than the "unfavored" children.

THE COLUMBUS INVESTIGATION

8. Bridges and Coler tested 301 children in two schools of Columbus, Ohio, by the point scale.[6] School A was in a very desirable residential district, the fathers mostly being professional or prominent business men. The other school, B, was in a poor factory district, where half the fathers were unskilled or casual laborers, many of the mothers worked, and half the families were recipients of some kind of charity. In both cases, however, all of the children were American-born of English-speaking parents.

The children in A were found to be from 21% to 32% superior to those of B; for a constant chronological age of pupil, there was a constant difference of two years in mental development. This difference was mainly in the tests demanding the higher mental functions, such as analysis and abstraction. Measured by the ordinary standards, nearly one-third of the children in B school would have been judged feeble-minded.

In the better school, two groups of thirty pupils each were chosen on the basis of their father's professions, and compared as follows:

	Chronological age	*Mental age*
Professional men	7 yrs. 7 mos.	9 yrs. 8 mos.
Traveling salesmen	7 7	9 3

That is, the offspring of the professional classes were found to be nearly half a year superior in intelligence to the children of traveling men. Two groups of seventeen each were compared on the basis of the following origin:

	Chronological age	*Mental age*
Clerks	7 yrs. 10 mos.	9 yrs. 1 mo.
Managers	7 8	9 5

The children of managers of business enterprises were two months younger in physical age, but four months older intellectually, than the children of clerks. A similar grouping in School B gave the following contrast:

	Chronological age	*Mental age*
Skilled labor	7 yrs. 11 mos.	7 yrs. 6 mos.
Unskilled labor	8 1	6 11

There were thirty-six children in each of these groups. Both were retarded. The children of unskilled laborers were chronologically two months older than their associates, but mentally seven months younger.

The authors make no attempt to

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[5] Yerkes, Robert M., and Anderson, Helen M. Social Status and Mental Capacity. *Journ. Educ. Psych.*, March, 1915.

[6] Bridges, James W., and Coler, Lillian E. The Relation of Intelligence to Social Status. *Psychol. Rev.*, xxiv, pp. 1–32, January, 1917.

decide whether these differences in level of intelligence are due to differences in heredity or in home training and surroundings. They do say, "The superiority of the better classes is most evident in tests that involve higher mental processes like analysis and abstraction; but it is also shown to a lesser extent in sensory-motor functions."

"If mental age rather than chronological age were used to determine the time for beginning school," they add, "the children of the professional group, for example, would begin school two years earlier than the children of the unskilled labor group; for the former mature intellectually much earlier than the latter." In fact, if the children of unskilled laborers were judged by the standard of the professional group, a majority of them would have to be called feebleminded. This, however,the authors say, is not a fair standard by which to judge them: they should rather be judged by the standard of their own group.

CONCLUSION

9. In conclusion, it appears that there are very considerable differences in the natural intelligence of children, depending on the social and economic status of their parents. These differences might be due to home training, surroundings, association with superior people, etc.; or they might be due to actual differences in inheritance of intelligence, which training and education cannot obliterate. There is a good deal of evidence, which need not be reviewed here, to prove that the latter supposition accounts for a large part of the differences.

Eugenics seeks to increase the reproductive rate of the superior part of the nation, and decrease that of the inferior part. It is of great importance that more studies like the above be made, which will show just what parts of the population are, intellectually, superior, and that it be definitely determined to what extent these differences are innate.

But even in advance of this, eugenic effort is not at all premature. It is probably safe to say that those who are successful in life are, on the average, eugenically superior to those who are unsuccessful: that is it better to encourage those who are able to support themselves than those who, because of some physical or mental defect, are unable to support themselves and are a burden on the community. This distinction alone is sufficient to justify the proper kind of eugenics propaganda, and will furnish ample occupation for eugenists for some time to come.

Methods of Investigation in Applied Sociology

Eugenists have frequently had occasion to condemn much of the evidence by which students of public health, social betterment and euthenics support their conclusions. Faulty logic and incorrect statistical methods vitiate a great deal of it and have led too frequently to the ignoring of the biological foundations. In recent years more trained men have been going into the work of organized charity, and have done much to reform the methods of investigation. But the need for more care, and the ways in which it can be applied, are still too little recognized, and the Russell Sage Foundation (130 E. 22d St., New York) has done a service in publishing a pamphlet (price 20 cents) containing papers by Donald B. Armstrong, Franz Schneider, Jr., and Louis I. Dublin, with the general title "Methods of Investigation in Social and Health Problems." A study of this pamphlet is recommended to everyone who is interested in intelligent social betterment; it will shake his faith in much of the work that has hitherto been done by euthenists, but will give him an understanding of the exact methods by which such investigations must be conducted, if they are to furnish the basis for effective reform. Eugenists, too, can learn much which will make their own work stronger.

URBAN STERILIZATION

Effect of City Life in Cutting Down Increase of a Superior Population Is Shown by New Figures—Native-Born American Stock Fails to Hold Its Own in Most Parts of the United States

THAT the natural increase of city populations is much slower than that of country districts has long been well known.

If there is a constant removal of country people to the cities, if those who move are more energetic and capable than those who stay on the farm, and if this removal to the city results in a lower birth rate and a higher death rate, it is evident that great cities are a sterilizing agency, selecting the best part of the population and cutting down its racial contribution. Cook[1] and others have pointed out the importance of this eugenic problem.

It has been difficult to find statistics which would show the real size of the problem, but John M. Gillette, professor of sociology in the University of North Dakota, has lately made several contributions to the study which throw a great deal of light on it.

First as to the actual extent of migration from country to city. According to the census of 1890, 36.1% of the population of the United States was urban, that is, found in places of more than 2,500 inhabitants. In 1910 the urban population had increased to 46.3% of the whole. But this increase is by no means wholly due to migration from country districts, since the cities also grow by their own excess of births over deaths, by foreign immigration, and by incorporation of surrounding suburbs.

Between 1900 and 1910 the urban population of the United States made an actual gain of 11,826,000, and Gillette calculates[2] that 29.8% of this was made up of those who moved from the farm into the city.

The amount of rural depopulation is therefore considerable, even though less than has sometimes been supposed. The second question is how much the natural increase of these families will be cut down by their removal to the city.

Natural increase means the excess of births over deaths and is hard to calculate in the United States, because only a few states register births fully. But Dr. Gillette has reached a solution in several indirect ways and is convinced that his figures are not far from the truth. They show the difference to be very large and its eugenic significance of corresponding importance.[3]

"When it is noted," Dr. Gillette says, "that the rural rate is almost twice the urban rate for the nation as a whole, that in only one division does the latter exceed the former, and that in some divisions the rural rate is three times the urban rate, it can scarcely be doubted that the factor of urbanization is the most important cause of lower increase rates. Urban birth rates are lower than rural birth rates, and its death rates are higher than those of the latter."

Considering the United States in nine geographical divisions, Dr. Gillette secured the following results:

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[1] Cook, O. F., Eugenics and Agriculture, JOURNAL OF HEREDITY, vii, pp. 249–254, June, 1916.
[2] Gillette, John M., Constructive Rural Sociology (2d Edition), p. 89, New York, 1916.
[3] Gillette, John M., A Study in Social Dynamics: A statistical determination of the rate of natural increase and of the factors accounting for the increase of population in the United States. Quarterly publications of the American Statistical Association, n. s. 116, Vol. xv, pp. 345–380, December, 1916.

RATE OF NET ANNUAL INCREASE

Division	*Rural*	*Urban*	*Total*
New England	5.0	7.3	6.8
Middle Atlantic	10.7	9.6	10.4
East North Central	12.4	10.8	11.6
West North Central	18.1	10.1	15.8
South Atlantic	18.9	6.0	16.0
East South Central	19.7	7.4	17.8
West South Central	23.9	10.2	21.6
Mountain	21.1	10.5	17.6
Pacific	12.6	6.6	9.8
Total United States.	16.9	8.8	13.65

Even though fuller returns might show these calculations to be inaccurate, Dr. Gillette points out, they are all compiled on the same basis, and therefore can be fairly compared, since any unforeseen cause of increase or decrease would affect all alike.

It is difficult to compare the various geographical divisions directly, because the racial composition of the population of each one is different. But the difference in rates is marked. The West South Central States would almost double their population in four decades, by natural increase alone, while New England would require 200 years to do so.

Dr. Gillette tried, by elaborate computations, to eliminate the effect of immigration and emigration in each division, in order to find out the standing of the old American stock. His conclusions confirm the beliefs of the most pessimistic. "Only three divisions, all Western, add to their population by means of an actual excess of income over outgo of native-born Americans," he reports. Even should this view turn out to be exaggerated, it is certain that the population of the United States is at present increasing largely through immigration and the high fecundity of immigrant women, and that, as far as its own older stock is concerned, it has ceased to progress.

To state that this is due largely to the fact that country people are moving to the city is by no means to solve the problem, in terms of eugenics. It merely shows the exact nature of the problem to be solved. A solution might be two-fold.

EUGENIC REMEDIES

1. Attempts might be made to keep the rural population on the farms and to encourage a movement of the superior elements (not the slum dwellers) of the cities back to the country. Efforts to improve rural conditions, economic and otherwise, and to secure a more general recognition of advantages of country life take on eugenic significance from this point of view.

2. The growth of great cities might be accepted as a necessary evil, an unavoidable feature of industrial civilization, and direct attempts might be made, through eugenic propaganda, to secure a higher birth rate among the superior families of the city population.

The second method seems in many ways the more practicable, since it is certain that great cities have come to stay, in the United States. On the other hand, the first method is in many ways more ideal, particularly because it would not only cause more children to be born, but furnish them with a suitable environment after they were born, which the city cannot do.

These suggestions involve the assumption that the birth rate of a family is directly affected by removal from country to city, and *vice versa*. It must be recognized that Dr. Gillette's statistics do not prove this assumption. They merely show that the country has a higher rate of natural increase than the city; this might be, and doubtless is, due to the interaction of a great number of psychological, physiological and racial factors. But it seems probable that the assumption made is true; that in some degree removal to the city does reduce the size of a family; and, contrariwise that removal to the country will increase the size of a family.

If this is true, then endeavors to colonize a lot of urban slum dwellers in the country, as by the Salvation Army and other agencies, are dysgenic, to the extent that these slum dwellers represent inefficiency due to inherent defect. Every effort should be made to reach the superior part of the population, in either one or other of the two ways suggested.

In practice, the problem will undoubtedly have to be attacked by eugenists in both of these ways. Dr. Gillette's statistics, showing the appalling size of the problem, ought to be a stimulus to eugenic effort.

DEGENERATE PLANTS

When Widely Different Varieties or Species Are Crossed, the Extreme Variants in the Second Generation Are Frequently Either Dwarfs or Giants, and in Both Cases Lack Reproductive Power—Notes from the Breeding-Ground

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THE term "degenerate" is, of course, one that does not admit of a clean-cut definition, and therefore it is here employed in a somewhat general way for those plants that show some weakness that interferes more or less with their successful struggle for life.

A gathering up of these notes was suggested by a recent study of results obtained from the breeding of musk-melons and therefore some observations drawn from these crosses, with photo-engravings, may serve as more than an introduction.

The chief combination we have made among the melons has been between a standard type, the Burrell Gem, and a recent novelty of the dwarf group, the Henderson Bush. The cross was secured in only one direction, namely, the vine upon the bush, all reciprocal attempts being failures otherwise than in emphasizing the fact that breeding is not effected with equal ease in both directions among diverse types of plants.

In the F_1 there were sufficient plants grown to make it clear that there was no observed effect of the bush upon the offspring so far as size of the plant is concerned. It is, however, possible that any restraining influence of the bush may have been offset by the stimulation that is generally ascribed to a cross in its first generation.

In the F_2 the plants were of the distinct parental types without any tendency to produce intermediates; in other words, there was an expression of the Mendelian ratio in the following figures: standards 69.2%, dwarf 30.8%.

Fig. 11 shows, upon the left hand, a portion of a vine plant coiled upon itself to bring it within the allotted space, while to its right is practically the whole of a bush plant, the leaves having been removed from both specimens that the character of the stems may be better seen. The eye quickly catches certain marked differences in detail, as, for example, the comparatively long, slender internodes in the vine type in striking contrast with the short and thick ones of the bush plant. The few remaining young leaves do not indicate the large difference in size in the mature foliage.

STEM THICKENS SUDDENLY

Attention is invited to the slender base of each branch in the bush plant. For one or more internodes the stem is similar to that of the vine but as soon as the region of bloom is reached, the internodes remain short and take on a remarkable thickening. The practical utility of the long, slender, basal internodes is not far to seek, for by this method of growth the extremely leafy portion of each branch is carried farther from the center of the plant and from the shade produced by the foliage of the main stem.

O. F. Cook[1] has suggested the term Brachysm for this shortening of the internodes as above mentioned, and is of the opinion that it is not an example of the beginning of a new character, although of much interest in the study of heredity and evolution.

The records show that the average weight of the ripe fruits from the vine plants was 692.2 grams and from the

[1] Brachysm—A Hereditary Deformity of Cotton and Other Plants. O. F. Cook, Journal Agricultural Research, Vol. III., No. 5, 1915.

TWO TYPES OF MUSKMELON

At the left is a standard vine type (Burrell Gem) coiled around itself, at the right a dwarf novelty, the Henderson Bush. The form of the latter is really degenerate, the stem being shortened and thickened in most of its length; and the fruits produced are as degenerate as the plant. Many of the most valuable commercial varieties of fruit and vegetable, and still more ornamental plants, are degenerates from an evolutionary point of view, and would not survive long in a struggle for existence with their wild relatives. (Fig. 11.)

bush plants only 199.2 grams. This is a remarkable positive correlation between size of plant and that of its fruits. Furthermore, the majority of the ripe fruits from the vine plants had salmon flesh like that of the vine parent, while the small fruits, few in number, of the bush plants were with one exception green fleshed, like the Henderson parent. In other words, there was an apparent linking of the factors for weight and flesh color (and shape as well) that may be attributed in part at least to the lack of vigor in the bush type. Whatever caused the brachysm, it may be assumed, acted to restrain the development of the fruits as well as the internodes; this influence extended even to the ripening of the melons and found expression in the failure to take on the salmon flesh-color characteristic of mature fruits of healthy, vigorous plants.

A form of degeneracy quite comparable with that shown in the muskmelon is found among commercial varieties of peppers that are grouped for this reason under the name of "clustered peppers." Plants in this category have very short internodes in the portion of the stem where flower buds form. This occurrence brings the forming leaves close together as well as any fruits that may afterwards form among them. These clustered leaves form usually long petioles with narrow blades, thus producing two types of foliage upon the same plant. Furthermore, the abortive stem, failing to continue its elongation, must rely upon the clustered leaves for photosynthesis and these are as a rule long-lived, take on an unusual thickness, and consequently become of a rich dark green color.

The Red Cluster is a common com-

mercial fascicled pepper and has been freely used in the breeding work of the experiment station. In the Golden Queen, a standard yellow-fruited sort, there are many characters that pair well with those of the Red Cluster. Thus the Cluster is a small, low plant with long, narrow leaves, and the fruits are small, upright, slender and hot; while the Queen makes a tall, much-branched plant with large normal leaves and bearing large, pendent, yellow, sweet fruits. These facts are mentioned to show that along with the chief distinction of internodal growth are a number of other opposing characters and confirm the opinion that the cross between these two kinds of peppers is a fairly wide one.

It was comparatively easy to secure combinations of the Queen upon the Cluster, but the large number of attempts to get the reciprocal have failed excepting in rare instances, and this work has been repeated each year for several seasons. The few plants that have formed the F_2 of the Cluster upon the Queen have exhibited a mixture of the two types of internodal growth (normal and brachysm), usually formed but few flowers of abnormal structure from which fruits rarely grew and these were seedless or nearly so. All attempts to breed these plants with the parents varieties have failed.

It is noted that the direction of this cross is the same as that in which no cross was obtained with the muskmelons, namely, the degenerate upon the normal type.

Many thousands of plants have been grown in the first five generations of the cross of the Queen upon the Cluster and, so far as the brachysm is concerned, conform closely to the rule of a Mendelian recessive; that is, it did not appear in the F_1, but practically in the ratio of one to three in the F_2. It might be remarked in passing that these crosses as grown in the seedbeds for setting in the field rarely showed any indication of brachysm, that is, the young plants were normal in stem- and leaf-development up to the place where the first flower bud is to form. If the setting were delayed until the plant bloomed, the grower would be able to eliminate the degenerates.

MANY ABNORMALITIES

In the F_2, for example, a field of a few thousand plants presented all imaginable combinations of the various characters of the parents in their association with brachysm; some of them were pitiable or amusing as the observer may decide. For example, there were low, unbranched plants with the stem ending in a single sphere of large, broad leaves the tips of which reach down to the ground all around the plant, the whole suggesting a dust mop. Within this head of foliage there may be a fruit or so of the Queen type pendent and sadly cramped and distorted by its fellows. Again the plant may have formed a large head from which stems emerged and ended in heads of leaves and fruits like the one from which they came, and in turn sent up normal stems that repeated the clustered habit of growth, so that a "three-story" plant may be seen at the close of the season. Brachysm is so closely associated with flower bearing that when the vegetative functions only are active the stems and leaves are normal.

The crosses in question show that when the fascicled type of foliage expressed itself there were associated with it more or less fully those characters common to the Red Cluster parent, namely, small size of plant and fruit and non-prolificness; and here, as has been noted with the muskmelon, there seems to be a causal relation that needs to be borne in mind by those who would deduce rules of breeding from such degenerates.

Figure 12 shows one of the dwarf pepper plants upon the left in striking contrast with the standard type of the same cross that occupies the main portion of the engraving.

In breeding tomatoes many unusual plants have come to light. For example, several years ago, while breeding the Dwarf Champion with Golden Sunrise to obtain a beautiful blush-cheeked kind (an *ignis fatuus* perhaps, long since abandoned), an F_2 plant was obtained, among hundreds of the normal type, that attracted much attention because

DWARF AND STANDARD PEPPER PLANTS

At the left is a dwarf plant of full size, bearing ripe fruits; beside it is a normal plant of the same cross. The two were photographed as they stood in the field. These dwarfs are degenerates which appear in crosses made in commercial strains of plants; sometimes they are of value to the gardener, but more frequently not. (Fig. 12.)

of its extreme size, the crinkly type of leaf and its few small and nearly seedless fruits. This plant has become the parent of a race of tomatoes that under the name of Oligosperm has bred true within itself but does not unite with other kinds. The attempts to combine this mutant with various commercial varieties have failed and, so far as breeding goes, it seems to be outside the scope of the tomato expert.

In the above instance it appears that we have a degenerate that is primarily characterized by its great size. The interest that centers in the possible behavior of its yet unknown offspring from union with its allies can be imagined, for it does not conform to the type of abnormality that has been here considered in the muskmelon and the pepper. In the present instance the unusual nature of the outcrop is to be seen in the peculiar cotyledons and many minute details of the growth of the giant, and it is placed here among the degenerates because of the extreme weakness of its reproductive organs (that may have a causal relation to its vegetative vigor) and its lack of sexual affinity with plants that are its closest kin.

Within recent years and in connection with other tomato crosses similar abnormal plants have appeared, but the

lack of reproductive power has prevented their continued propagation and crossing with ordinary plants.

DEGENERATE EGGPLANTS

In the breeding of eggplants there have appeared plants that may deserve a place among the degenerates. Here as in the last mentioned cases the abnormal individuals have come from parents that conformed to the usual type but were in combinations between well-marked species and not the more simple crosses of commercial varieties. For example, when the *Solanum melongena* is bred with *S. integrifolia* there results at once a set of unexpected giant plants that are very much larger than either parent, and as a rule bloom profusely but form fruit at rare intervals. Many plants, the largest ones, are entirely barren, while the smaller specimens produce enough seeds for the continuation of the stock. Unlike the Oligosperm these degenerates are less infertile and have frequently been bred with their parents.

In the F_2 of the eggplant hybrids there is a range of plants all the way from dwarfs that are bloomless to giants with countless flowers but nearly fruitless, as in the F_1. Here the extremes represent the two types of deficient plants. The union that brought the series into existance was obtained with much difficulty and is not looked for in a state of nature, while should it occur there are reasons for expecting that it would soon disappear as lacking the qualities that make for a continuation of the species.

The Prairie berry (*Solanum nigrum*) in the hands of the breeder has behaved in a manner that suggests a notice here. Dr. Groth had the type species and the green-fruited variety in the breeding grounds for years, and the crosses which were secured after a very long series of failures exhibited a variety of forms that seemed to be limited only by the number of individuals grown. Thus, from normal parents there was obtained a small percentage of dwarfs of two sizes, the smaller being only 5 cm. in height. There were upright plants and those that remained prostrate upon the ground. They varied in shape and size of leaf, flower and fruit, the latter being black, green or piebald when ripe; some very acid, others sweet, etc. As a rule the Prairie berry is a selfed species and it has been determined in many instances that the F_2 type is perpetuated with a fair degree of uniformity.

Here, as among other subjects in this paper, the degenerates are the extremes among the progeny, namely, the remarkable dwarfs usually with few or no fruits and the largest plants bearing almost no seeds. It is likely that the latter are big because they are barren. A series of tests has been running for several years to demonstrate the effect of the prompt removal of all flowers as they appear upon normal plants, and the results show that the natural life of the deflowered plant is prolonged and the size much augmented.

From a study of mounted plants in the larger of American herbaria it is evident that the species under consideration is remarkably variable, although no dwarfs were found. It seems to be probable that interbreeding infrequently takes place in nature and because of the selfing habit many types are widespread. The dwarfs, while they may make up a small fraction of the wild plants, would be passed by as unworthy of consideration by the collector.

SURPRISES FROM BEANS

The breeding work with beans has been fruitful in obtaining results that warrant mention here. For a time surprises attended each step, particularly as to the range of possible unions. Selfing prevails among the several species and natural crosses between different varieties of the navy bean (*Phaseolus vulgaris*), while they occasionally occur, are quite exceptional. Failure has attended all the many attempts to breed between certain species of the genus, as, for example, the Lima and snap beans. With the Scarlet Runner (*P. multiflorus*) the results have been more successful and it is of these unions among beans that mention is here made. E. J. Owen, who has immediate charge of the breeding with beans, has been unable to get hybrids in both directions, and

only a very small percentage of the attempted combinations of the Scarlet Runner upon bush snap beans have been successful. It should be stated that only a small percentage of the blooms of a Scarlet Runner inflorescence produce pods and therefore hope still lingers that by multiplying the attempts success may be achieved.

These hybrids have been in the breeding grounds for several years and they follow the general rule of producing in the F_2 an extremely wide range of plants. For example, there were dwarfs, some of them so small as to attain only a few inches in height, with the small leaves near each other, and producing no flowers. Other plants went to the opposite extreme in size and spread out in all directions from the tip of a tall pole, abounding in blooms and yet yielding no fruits. During the last season there was a block of a hundred hills of this hybrid and no two plants were alike in all respects. A majority of the set did not produce seed but there were a number in the intermediate class that were fairly prolific. In years past plants of remarkably high productive power have been selected and continued through some generations with the prolificness unimpaired. From all the light that has been thrown upon the subject by long association with these hybrids it seems probable that the factor for seed-production will be inherited with some degree of uniformity where the plants are left to their own devices.

Again, it is noted that a union made between two species is followed by the production of a set of offspring a number of which answer to the general meaning of degenerates, and, furthermore, these deficient plants are of two opposite and extreme types, namely, those of feeble growth and unusually weak in reproductive power, and, secondly, the giants of the cross that while surcharged with vigor as expressed in unlimited growth are barren or nearly so.

WEAKNESS OF SWEET CORN

The above instances do not by any means exhaust the list of defective plants that have come from the work in breeding. In fact, a large part of the researches has been with crosses of plants that already have a weakness and in so far are degenerates. A most familiar instance is the sweet corn. Here the mother plant lacked the active factor of storing an ample supply of starch in the maturing kernel and the offspring must do as best it can with the sugary content of the grain. It is a well-understood fact that such shriveled corn is comparatively low in viability, and when the soil is damp and cold may fail to produce plants where the common type of grain thrives. When the two last named types of corn are bred together there is frequently a large percentage of the F_1 plants that are albinos and therefore fail to mature. The same is true of the crosses of the Cuzco with our largest types of field corn, and further, it was found that the plants, while as a rule of strikingly large size, were entirely unprofitable for crop-production. This albinism may be only partial, the plants outgrowing the weakness; and, furthermore, this defect is sometimes racial in corn as for example the variegated kinds that are grown for ornament. A study of these latter kinds leads to the opinion that as a rule they are of low stature and produce few and small ears. It is well to rank such varieties as degenerates, for they produce a large percentage of plants with deficient vigor and it would be a disadvantage to have them reproducing in a field of normal corn.

Many variegated ornamental plants are recessive to the solid green or normal chlorophyllous plants. Some breeding work is now in progress with nasturtiums in which it is shown that the varieties with the dark green leaves are dominant in that character over those with pale green foliage, and both of these are dominant when bred with the variegated sorts. In other words, the kinds least fit to use the sunlight in their life processes are recessive. The same rule holds with peppers that have pale green leaves and unripe fruits and no exception, as far as is recalled, has been met with on the breeding grounds.

In passing it might be mentioned that the wrinkled peas are comparable with sweet corn in the failure of the seeds

to lay down a normal supply of starch and the seeds are of comparatively low viability. Other kinds have the legumes and surrounding stem devoid of the normal supply of chlorophyll (wax-podded). These sorts, with us, have been noticeably weak in stem, requiring tying to stakes at frequent intervals, yield but few seeds and breed with much difficulty. All such plants that lack the full complement of nourishment in the seed and chlorophyll in the plant are poorly equipped for the struggle of wild life.

In the same category is included the large group of wax-beans also recessives to their green-podded relatives. Here the failure to produce chlorophyll does not extend far beyond the pods and the vigor of such varieties is not greatly diminished.

The above observations have been drawn from the records of breeding work that has been carried on for other purposes than the particular study of degenerates. It seems to me that the degenerates, as they have been used in the work, are not forceful as compared with the normal type. The appearance of unfit individuals seems to result from the breeding together of kinds that are not congenial because of one or more of many possible reasons. Such unions are forced and the greater the lack of consanguinity, within the comparatively narrow range of possible union, the larger the number of defectives. These misfits belong to the two extremes of a large series of types, namely, those that show from the start a feebleness that results in restricted growth and reproduction; and secondly, those in which excessive vegetative vigor is associated with partial or entire barrenness. Such unions are vital to the progress of our knowledge of heredity, but along with the creations of great value there are obtained many defectives that from the practical side need to be surpressed.

WORTHLESS NOVELTIES

No thoughtful person would decry the widest possible breeding among plants in order that the range of unions may become well known, but at the same time a novelty does not spell superiority and it calls for true courage upon the part of the originator to cast the bulk of his pets into the burn heap.

When a plant having an inherited deformity or weakness is bred with the normal type its abnormality usually enters into the union as a recessive and is subject to great modifications through future generations. Records show that there is a linkage or coherence between the dependent characters in the degenerates of the cross; *e. g.*, size of fruit and size of plant.

Such breeding, because of the many failures, calls for much patience, and one is fortunate in getting the union reciprocally.

Recessives when the characters involved are related to plant stamina as lack of size, of chlorophyll, or of fruitfulness are weak, and in so far are unfit, but this does not include the great mass of recessives as regards form of flower, fruit and seed, etc.

Unless the degenerates are grown for the special character that is their weakness (such commercial strains are numerous and valuable), they might well be kept from mingling with the healthy types.

The Extremes of Intelligence in School Children

Not far from 2% of the children enrolled in the public schools must be looked upon as real defectives, according to Prof. Lewis M. Terman of Stanford University (*The Measurement of Intelligence*, 1916). The number of children with very superior intellectual ability is approximately as great as the number of feebleminded, he thinks; and upon this superior 2% "the future welfare of the country hinges in no small degree." He finds that teachers usually overestimate the intelligence of the inferior children and underestimate the intelligence of the superior ones. There is great need for the use of reliable mental tests in education, if the children of superior ability are to be recognized and given the opportunities which they deserve.

AN OFFICE-HOLDING FAMILY

Descendants of One Massachusetts Man Have Held an Unusual Number of Offices of Public Service and Trust Through Six Generations—Eugenic Significance of Such a Pedigree—Genealogists Should Pay More Attention to Civic Worth in Their Histories

MERTON T. GOODRICH, *Jay, Me.*

IN a monarchic country, office-holding tends to be a prerogative of families which have wealth and social position. It has not necessarily a very high correlation with eugenic worth. But conditions in a democracy are different. Here, the candidate for office is judged very largely on his own merits. When a local, non-partisan office is to be filled, the voters almost invariably consider the qualifications of the candidate and care very little about the record of his father. Even in partisan politics but little is said concerning family history. While it cannot be said that the best qualified man is always the one elected, while it may be admitted that factors outside of personal worth sometimes influence the result of an election; it is true that in a democracy the people will not allow a man to remain in an elective office for long unless he is superior in some way to his competitors. Therefore, if a family in the United States should possess for several generations many members who had held local, non-partisan offices and served for a long time in these positions, it would seem to be something worthy of study from a eugenic point of view, it might indicate the inheritance of certain traits which the people expect such officers to possess.

While compiling the genealogy of a certain New England family, I found a large number of members who had held public office. I shall present the facts in this paper, and point out some of the ways in which I think they have eugenic bearing.

The family is of Anglo-Saxon origin, the several lines of ancestry having been traced back to English immigrants who settled in Massachusetts between 1630 and 1640. So far as can be learned these ancestors were no different from the majority of Puritans. None of them held public office.

THE FIRST GENERATION

Our study begins with a man whose paternal grandfather came from Suffolk County, England, in 1634. His wife's father and grandfather came together from Southampton in 1635. He moved with his family from the town in which he was born to a town in the central part of Massachusetts. He was one of the first settlers of this town and was active in bringing about its incorporation. He was elected to several town offices but lived only nine years after he moved there. There were twelve children in the family. all of whom lived to grow up. Of the seven boys, five held town offices, one of them being town clerk twenty years and chairman of the board of selectmen thirty-eight years, but of the public life of the other two nothing is known. Public officers are also to be found among the children and descendants of the five girls who married men of more or less local prominence. In fact, throughout the genealogy, the presence of office-holders among the female branches seems to be nearly, if not quite, as common as among the male branches. This may be accounted for to some extent by assortative mating such as that just noted.

Office-holding certainly cannot be spoken of as an inherited trait. The facts available do not even disprove that it is wholly a matter of education and environment, to one who leans toward that explanation. But the fact that a large proportion of the members

of this family, for generation after generation, occupied public offices seems to me to indicate that they possessed certain inherited abilities and dispositions which favored public service.

The majority of the offices held by the members are those of selectman, town clerk, town treasurer, school-committeeman, minister of the gospel, physician, and teacher. While the last three positions are not strictly public offices, they are positions of public service and as such need to be included in the list. Only those who made teaching a profession are listed as teachers. I include also minor offices such as constable, tax collector, and justice of the peace. A few members of the family have held State and national offices, but a far greater number have held offices of purely local influence and non-partisan character. The nature of the offices indicates the presence of a spirit of public service rather than one of political ambition, an interest in local matters rather than a broad grasp of national affairs. The exceptions to these characteristics are found in those cases where the members have had superior education.

FEW ACQUIRED WEALTH

There is nothing in the constitution of New England society which would oblige the members of the family to take up, in so many instances, labors which were arduous and which brought little—in many cases no—remuneration. It is further interesting to note that there is scarcely an individual in the whole genealogy who possessed even a moderate amount of wealth.

Office-holding in this family is, therefore, not part of the tradition of a wealthy, governing class, as it might be in England. It is not a means of getting rich. It is apparently due to some peculiar mental characteristics and I believe that these include a certain amount of intelligence, conscientiousness, altruism, probity, and industry, with a lack of competitive aggressiveness and the commercial spirit.

The presence of these characteristics is further emphasized by the large number of male and female teachers in the younger generations. Indeed, teaching is practically the only position of public service in which females could make manifest the possession of these characteristics. Undoubtedly, many individuals who possess these traits were barred by sex or some other cause from filling the positions they were by nature qualified to fill. The trait of lack of aggressiveness, if stronger than the others, would overcome them, and prevent an individual who had inherited these traits from holding public office and from being included in the records among those possessing the family traits. It is evident, then, that the percentage of public officers shown by the tables underestimates the prevalence of these traits.

The mental qualities which I have mentioned have hereditary bases of some kind. So although office-holding is not to be considered an inherited trait, it seems to me reasonable to think that there are inherited traits particularly favorable to it, and that they were inherited with considerable persistency in a family which, in a democratic country, furnished so many men and women for positions that meant public service with hard work and little pecuniary reward.

FULLER DATA NEEDED

It may be of interest to note that among the descendants of the relatives of the founder of the family occasional instances of office-holding have been found, but the instances are too scattered and the data too incomplete to make possible the drawing of a definite conclusion. The scarcity of data in most genealogies in regard to the public life and traits of different individuals is a great handicap in studies of this kind. I believe that the need of recording complete data in regard to the mental, moral, and physical characteristics of individuals as well as the facts of birth, marriage, and death can not be pointed out too strongly to genealogists. I believe also that female branches should be treated with the same completeness as male branches and with as full a bibliography as

possible of the data concerning the female branches published in other genealogies. It is a matter of good fortune that through the coöperation of members of this family who are interested in genealogy and through the assistance of town clerks in the study of their records, I was enabled to obtain fairly complete data in regard to this family.

The recent history of the family is of some interest. After the Revolution in which at least one son and four grandchildren of the founder were engaged, several descendants migrated from Massachusetts to Maine, New Hampshire and Vermont. It will be remembered that the founder helped incorporate a Massachusetts town. A grandson was influential in bringing about the incorporation of a town in Maine of which he was one of the first settlers. Between 1830 and 1860, many members of the family went west. Eighteen members of the family are known to have served in the Civil War. Of these, eight were killed—all young men of promise including a young surgeon and a captain. After the Civil War the number of emigrants was greatly increased, until now the descendants of the family are to be found in nearly every northern State.

There is no evidence to show that this family is superior to others of similar composition. Doubtless other families might in some cases show the inheritance of the same traits and possess a correspondingly large number of public officers. The accompanying tables show the amount of public service performed by this family:

In this table (I), the per cent of members holding public office is shown to have decreased from generation to generation. I am not certain as to the true explanation of this fact. While it must be largely due to the increasing size of the generations, there may be genetic factors involved. It seems possible that the members of the second generation inherited from both parents certain traits not particularly strong in themselves, but which by combination produced a strong group of transmissible characteristics made manifest by office-holding; and that this group of traits has in the successive generations been made weaker and weaker by the introduction of inherited traits of an opposite nature. The small number of individuals recorded in the seventh generation is due to the fact that this generation is too young to have many members which have reached maturity.

An interesting thing to be noted in the second table is the decrease in the number of selectmen and town clerks and a corresponding increase in the number of teachers and physicians in the younger generations. This is suggestive, but the figures are hardly sufficient to warrant a general conclusion. The large number of minor officers does not indicate a preference for that kind of office, because a very large number of those who filled minor offices afterward filled more important ones. The number of female teachers is additional to the number of public officers, all of whom are males. It is obvious that the same individual frequently held several offices, at the same or different times.

TABLE I.—*Public Life*

	Generation							Total
	1	2	3	4	5	6	7	
Mature males	1	7	28	47	61	125	33	302
Public life known	1	5	21	42	57	94	24	244
Public officers	1	5	17	21	25	29	7	105
Per cent	100	100	81	50	44	31	29	43

TABLE II.—*Nature of Offices*

	Generation							Total
	1	2	3	4	5	6	7	
Public officers	1	5	17	21	25	29	7	105
Town clerks	0	3	1	1	4	2	0	11
Selectmen	1	3	3	4	7	4	0	22
Town treasurers	0	2	2	1	0	2	1	8
School-committeemen	0	0	0	1	4	3	1	9
Minor town officers	1	3	15	17	13	16	2	67
State or national	0	0	0	1	1	1	0	3
Ministers	0	0	1	4	4	3	0	12
Physicians	0	0	0	1	4	3	3	11
Male teachers	0	0	0	0	0	2	4	6
Duplicates	1	6	5	9	12	7	4	44
Female teachers	0	0	1	5	6	9	2	23

TABLE III.—*Inheritance of Traits*

	Generation							Total
	1	2	3	4	5	6	7	
Public officers	1	5	17	21	25	29	7	105
Neither grandfather nor father an officer	1	0	0	0	0	0	1	2
Grandfather an officer but father not	0	0	0	2	5	5	0	12
Father not an officer	1	0	0	2	5	5	1	14
Connected by the mother	0	0	6	5	2	9	1	23
Father an officer	0	5	11	14	18	15	5	68
Three generations of officers	0	0	8	9	12	8	2	39
Four generations of officers	0	0	0	9	12	8	2	31
Five generations of officers	0	0	0	0	12	8	2	22
Six generations of officers	0	0	0	0	0	8	2	10
Seven generations of officers	0	0	0	0	0	0	2	2

In the above table, the number of officers shown connected with the family by the mother is much smaller than that connected with the family by the father, but this is largely due to the incomplete data concerning some of the female branches. It should be noted that whenever three consecutive generations have been public officers, all the direct ancestors back to the first individual have been public officers.

TABLE IV.—*List of More Notable Members*

1. Two Representatives to the United States Congress, both serving several terms.
2. A delegate to the provincial congresses at Concord and Cambridge.
3. A clerk of courts, serving 16 years.
4. Selectmen and town clerks with long terms of office, usually held at the same time:
   (*a*) Selectman, 10 years.
   (*b*) Selectman, 22 years; town clerk, 15 years.
   (*c*) Selectman and town clerk, 36 years, died in office.
   (*d*) Selectman, 22 years; town clerk, several years.
   (*e*) Selectman, 19 years; town clerk, 17 years.
   (*f*) Selectman, 8 years; town clerk, 20 years, now in office.
   (*g*) Selectman, 38 years; town clerk, 20 years.
5. School-committeemen with long terms of office:
   (*a*) School-committeeman, 12 years.
   (*b*) School-committeeman, 27 years; stated that he had rather be a member of the school committee than be President; died in office.

(*c*) School-committeeman, 56 years; also taught 97 terms of school.
6. Postmaster, 44 years; member of New Hampshire legislature several terms.
7. Pastor of one church for 40 years.

It is a matter of some importance to eugenics to know whether a stock has small or large variability. The Jews, for instance, as Dr. Maurice Fishberg has pointed out, have produced an exceptional number of eminent men, but at the same time they have produced an exceptional number of mental and physical defectives. No such condition exists in this family. Its record in each generation has been about the same. None has been rich, but none has ever been a pauper or a criminal. None has been a genius, but there is no record of feeblemindedness, and only four cases of insanity among the 803 individuals recorded. These cases occur in the fourth and fifth generations, one each, and two in the sixth generation; the three latter cases being in a female branch. The records of some 500 descendants of brothers, sisters, and cousins of the founder of this family show also an absolute lack of extremes. In this respect the family contrasts with some of the more famous New England families.

TABLE V.—*Maturity*

	Generation							Total
	1	2	3	4	5	6	7	
Members	1	12	61	110	170	323	126	803
Maturity known	1	12	61	108	165	315	80	742
Matured	1	12	56	85	128	238	62	582
Per cent	100	100	91	78	77	75	77	78
Males	1	7	31	60	86	171	44	400
Matured	1	7	28	47	61	125	33	302
Per cent	100	100	90	78	71	73	75	75
Females	..	5	30	48	79	144	36	342
Matured	..	5	28	38	67	113	29	280
Per cent	..	100	93	79	84	80	81	82

TABLE VI.—*Longevity*

Age at death	Public officers		Mature males not officers		Mature females	
	Number	Per cent	Number	Per cent	Number	Per cent
90–99	3	0.029	1	0.007	7	0.025
80–89	11	0.105	2	0.014	20	0.071
70–79	17	0.162	4	0.029	24	0.086
60–69	9	0.086	13	0.093	16	0.057
50–59	4	0.038	8	0.058	9	0.032
40–49	1	0.009	6	0.042	12	0.043
30–39	2	0.019	10	0.072	20	0.071
21–29	0	0.	10	0.072	11	0.040
Living	23	0.219	45	0.324	65	0.232
Unknown	35	0.333	40	0.289	96	0.343
Total	105	1.000	139	1.000	280	1.000

Another matter of vital importance is to know to what extent valuable intellectual and moral traits are correlated with valuable physical traits. If the production of intelligence is encouraged, will that also encourage the production of sound children, or the reverse, as some who do not understand eugenics pretend? Again, Alexander Graham Bell has been advising that much weight be placed on family longevity in the choice of a mate; will or will not long-lived people be found to be above the average of the population in mental ability?

These are questions which must be answered fully, and on which there is now very little light. As I have pointed out, this family is not characterized by extreme mental development. It seems to be about the average in this respect. In the matter of physical development, some of the family histories make record of the fact that the men were large and well proportioned, the most striking record being that of a man, his brother, and two sons, who together measured 25 feet. On the other hand, several members of the family are known to have been smaller than the average. In these cases, however, the small stature can be traced to a parent who did not belong to the family. The extent of my study is too small to carry much weight, but the figures in regard to maturity and longevity are suggestive.

In the general population of the United States, at the present time, about 80% reach maturity (21 years). In an earlier period, the percentage who did so is known to be considerably smaller, but I am unable to present any figures that would be of value for direct comparison. I think the conclusion is justified, however, that the child mortality in this genealogy is not above the average; I am of the opinion that it would be found, on proper investigation, to be somewhat below the average.

It is well known that low infant mortality, and longevity, are correlated, both being due to the inheritance of a sound constitution. It is therefore to be expected that the family should show a large proportion of long-lived members. The greater number of long-lived males among the office-holders than among those who are known to have followed other careers is interesting but not conclusive. Most positions of public service favor long life, because they do not entail any particular exposure or risk. Further, the office-holders are a doubly selected lot: first, because one is usually not elected to office under 30 years of age, and the weaker members of the family by that time may have died; and second, because only men of strong vitality and endurance would take many of these offices, which meant work without pay outside of the individual's regular employment. But even allowing for these factors, there is indication (as one would *a priori* expect) that longevity is correlated with superior mentality and morality.

In sum, this family is marked by a tendency on the part of the males, and to a less extent the females, to choose occupations that are of the nature of public service. It is also marked by a good average of physical soundness, intelligence, and economic efficiency, with no great deviations from the average. It seems in some degree to meet the standard of "civic worth" on which Galton laid stress as an element of eugenics.

A TASK FOR GENEALOGISTS

One of the greatest difficulties which eugenics faces is that of deciding which part of the population is the valuable part whose increase should be encouraged at the expense of others. The general tendency is to make financial success the criterion, but this is not free from objection. Its great merit is that it is an easy test to apply; but it can be argued that financial success depends as much on opportunity as on ability; and that it sometimes represents cunning and selfishness, rather than constructive, altruistic traits. Without necessarily admitting the truth of these objections, one must recognize that the financial criterion is not perfect. It seems possible that genealogists, if they had the needs of eugenics in mind, might be able to supplement this criterion with others. If many families, or even considerable

strata of the population, could be found in which the members were marked by general physical, mental, and moral soundness, and by a spirit of public service rather than merely by one of money-getting, it ought to be possible to promote the fertility of such families by eugenic measures.

It is with the hope of stimulating genealogists to work from the point of view of civic worth, that the present paper is published.

THE INHERITANCE OF ARITHMETICAL ABILITIES

IT IS no longer possible to doubt that mental capacities are inherited, but the analysis of them is extremely difficult. Does a child inherit general arithmetical ability, for example, or is ability in subtraction different from ability in addition; or are all sorts of arithmetical ability merely due to the amount of training given to some more general form of intellectual capacity? Margaret V. Cobb has been studying this particular problem, and presents a preliminary report in the *Journal of Educational Psychology* (viii, pp. 1–20, January, 1917).

The abilities she considers are addition, subtraction, multiplication, division, and speed in copying a column of figures.

"The measurements made show that if, for instance, a child is much quicker than the average in subtraction, but not in addition, multiplication or division, it is to be expected that one at least of his parents shows a like trait; or if he falls below the average in subtraction and multiplication, and exceeds it in addition and division, again the same will hold true of at least one of his parents." These various kinds of arithmetic appear to be dependent on different functions of the brain, and are therefore probably inherited independently, if they are inherited at all. Furthermore, the inheritance must be segregating. All the children of the same family do not always resemble the same parent.

To assume that the resemblance between parent and offspring in arithmetical ability is due to association, training and imitation, is not plausible. If this were the case, a class of children ought to come to resemble their teacher, but they do not. Moreover, the child sometimes resembles more closely the parent with whom he has been least associated in daily life.

The details of Miss Cobb's study, which was made by means of correlations, cannot be conveniently summarized. They seem, however, to bear out her conclusion that heredity plays at least a considerable part in determining a child's ability at various arithmetical processes.

Lectures on Heredity in Washington

A course of three lectures on heredity was given by the Washington Academy of Sciences this spring, as follows:

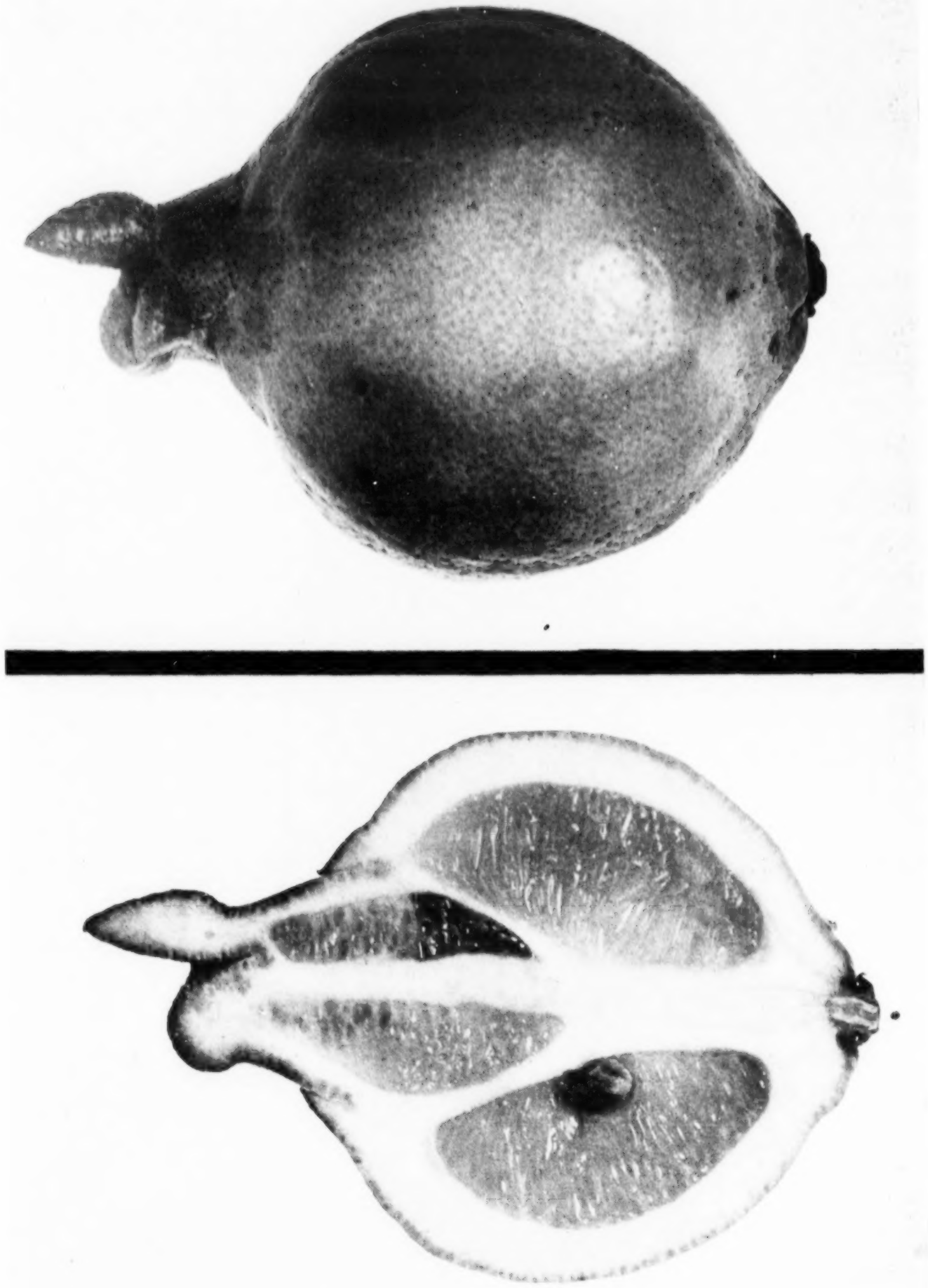
Prof. H. S. Jennings of Johns Hopkins University: Observed changes in heredity characters in relation to evolution. March 15.

Dr. Oscar Riddle, Carnegie Institution (Cold Spring Harbor, L. I.): The control of the sex ratio. March 29.

Prof. W. E. Castle, Bussey Institution, Harvard University: The rôle of selection in heredity. April 13.

These lectures are published in the Proceedings of the Washington Academy of Sciences, and can be obtained separately. Dr. Frederick Wright is secretary of the Academy.

A LEMON BUD VARIATION



The occurrence of navel fruits is rather common in citrus varieties. Frequent examples of such fruits have been found in the individual tree performance record studies of some of these varieties, other than the Washington navel orange, in California and elsewhere in citrus districts. For instance, several grapefruits with well developed navels have been found in Marsh trees. In the Valencia orange studies many fruits have been found with navels, but none was absolutely seedless. In picking the performance record lemon trees in California, navel fruits have been found occasionally. The accompanying photograph shows (natural size) a navel lemon with a large protruding navel. This fruit contained several seeds. It was produced by a normal tree bearing, except for this specimen, normal fruits. The trees of the Ruby Blood variety of orange, and the Dancy variety of tangerines, in California, produce very many fruits having navels. None of these fruits, however, that has so far been found by the writer, is seedless, or promises to be of any particular value commercially. They are interesting mainly from the standpoint of emphasizing the frequency of the occurrence of striking bud variations in citrus varieties. (Fig. 13.)

—A. D. SHAMEL, Riverside, Cal.

HOW BEES RECOGNIZE EACH OTHER

THAT bees recognize each other principally by the sense of smell is the conclusion of N. E. McIndoo, of the Bureau of Entomology, who discussed the subject at the last annual meeting of the American Society of Zoölogists. Most of his conclusions are confirmed by the work of other students.

"It is certain," he says, "that a queen gives off an odor, and it seems reasonable that the odors from any two queens would be slightly different. All the offspring of the same queen seem to inherit a particular odor from her. This odor, called the family odor, perhaps plays little or no part in the lives of bees, for it is certainly masked by the other odors. Drones seem to emit an odor peculiar to their sex, but little can be said about it. It seems certain that each worker emits an individual odor which is different from that of any other worker. It is also probable that the wax generators and nurse bees emit odors slightly different from those of the field bees.

"Of all the odors produced by bees, the hive odor is probably the most important. It seems to be the fundamental factor or principle upon which the social life of a colony of bees depends, and perhaps upon which the social habit was acquired; without it a colony of bees could not exist. The hive odor is composed chiefly of the individual odors from all the workers in a hive, and is supplemented by the odors from the queen, drones, combs, frames and walls of the hive, etc. From this definition it is easily understood why no two colonies have the same hive odor. The hive odor of a queenless colony is perhaps considerably different from that of a colony which has a queen. The absence of a queen odor in the hive odor probably explains why the workers in a queenless colony are irritable and never work normally. All the bees—workers, queens and drones—of a colony carry the hive odor of that colony on their bodies among the hairs. This odor serves as a sign or mark by which all the occupants of a hive 'know' one another. Since the queen and drones are 'aristocrats' they seem to disregard the sign that has been thrust upon them, but whenever a queen enters the wrong hive, she soon 'realizes' that she wears the wrong badge. Worker bees returning to the hive from the fields pass the guards unmolested, because they carry the proper sign, although the hive odor that they carry is fainter than when they left the hive, and it is also partly masked by the odors from the nectar and pollen carried by these bees.

ODORS MAY CHANGE

"Bees kept in the open air for three days lose all the hive odor carried on their bodies, but each bee still emits its individual odor. When a colony is divided the hive odor in each half soon changes so that by the end of the third day the original colony possesses a hive odor so different from that of the other half of the colony, that when the workers are removed from the two new colonies and are placed together in observation cages, they fight one another as though they had been separated all their lives.

"While a foreign hive odor calls forth the fighting spirit in workers, the queen odor always seems pleasant to workers regardless of whether the queen belongs to their hive or to another hive. Even though the queen odor forms a part of the hive odor, it is probable that this odor to the workers stands out quite prominently from the hive odor. That workers do not miss their queen for some time after she has left the hive, indicates that her odor thoroughly permeates the hive odor and that whenever this odor grows faint the workers 'know' she is not among them.

"There has been much speculation concerning the ruling spirit or power in a colony of bees. The writer is inclined to believe that a normal hive odor serves such a purpose. The hive

odor is a means of preserving the social life of the bees from without, the queen odor which is a part of it ensures continuation of the social life within. As already stated the workers 'know' their hive mates by the hive odor they carry. This odor insures harmony and a united defence when an enemy attacks the colony. The queen odor constantly informs the workers that their queen is present, and even though she does not rule, her presence means everything to the bees in perpetuating the colony. Thus by obeying the stimuli of the hive odor and the queen odor, and being guided by instinct, a colony of bees perhaps could not want a better ruler."

BODY AND MIND

Those who are Mentally Defective are Likely to be Physically Below Par as Well—Methods of Diagnosis—Superiority of the Left Hand and Small Lung Capacity Marked in the Feebleminded

BY THE use of mental tests, an experienced examiner can usually tell without difficulty whether a child is feebleminded or has normal intelligence. Everyone understands that the two types of mind are different, even if these differences are not sharply defined.

But the differences are not solely mental. Many persons who have had to do with feebleminded children have recognized that they were abnormal in body, as well as in mind.

As early as 1892, Porter concluded from a study of 33,500 children that there is a physical basis of mental precocity, that dull children are lighter in weight than the average child, and precocious children heavier; that mediocrity of mind goes with mediocrity of physique.

Smedley announced that the "evolutionary ideal child stands somewhere above the average in each measurement." He found that children who were physically superior were quite regularly superior in school efficiency. This conclusion was confirmed by several investigators.

On the other hand, several investigators found that feebleminded children were below par physically. From a study of 6,000 feebleminded males and 5,000 feebleminded females of all ages, Goddard demonstrated that with but slight exceptions the feebleminded of both sexes are below the normal averages, and that the degree of subnormality bears a direct relation to the degree of mental defect, with the highest grades, the morons, closely approximating the normal.

Among the confirmatory studies is that of Mead, who concluded that "not only is mental defect reflected on the average in the height and weight of children, but the more decided the defect, the more checked the physical growth," a result which was more evident in height than in weight. Feebleminded girls are more like normal girls than feebleminded boys are like normal boys, in his opinion. Again, Baldwin affirms that "the majority of school children above median height are in or above normal grade and above the average in marks. Of those below median height the majority of children are below or in normal grade and below average mark."

The Training School at Vineland, N. J., has for the past ten years been making physical measurements of its pupils, recording the height (standing and sitting), weight, grip (right and left), and lung capacity. These furnished good material for a further study of the relation between physique and intelligence, and more particularly of the relation between the various measurements to each other, and E. A. Doll, assistant psychologist, has submitted the records to statistical treatment and recently published the results.[1]

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[1] Doll, E. A. Anthropometry as an Aid to Mental Diagnosis. Publications of the Training School at Vineland, N. J. (Research Dept.), No. 8. February, 1916. Pp. 91, price 75 cts.

There are 477 sets of measurements from which those of children with physical defects are excluded. The results are expressed in coefficients of correlation.

Standing height.—The feebleminded of all grades are below normal[2] in standing height. There is a marked dependence of the degree of subnormality upon degree of feeblemindedness. The feebleminded not only grow tall at a retarded rate, but cease growing at an earlier age than normal children. There is naturally a good deal of variability, but the conclusion of other investigators is, in general, confirmed. Bright children tend to be taller than the average, and dull children shorter.

Sitting height.—This is consistently even more subnormal than standing height; that is, the feebleminded tend to be unusually long-waisted and short-legged. But the highest types, the morons, approximate the normal average. Of all feebleminded, 75% fail to reach the normal average.

Weight.—There is not such a marked connection here as in the height measurements. Among the higher grades of feebleminded, the boys are often normal and the girls above normal. In the lower grades, among idiots and imbeciles, weight is often considerably below par.

Right grip.—Barr has aptly said that strength of mind and strength of hand accompany each other. Only 10% of the feebleminded have a normal grip.

Left grip.—Goddard has for some years held that the feebleminded are markedly below normal in strength of grip, with left superior to right (even when they are not left-handed, in ordinary employments). Doll finds this conclusion borne out by the measurements. They do not show a tendency to ambidexterity, but toward actual superiority of the left hand, in all ages and grades of children. In low-grade individuals there is often almost no power of grip in tests, because of mental defect, although the individual may be physically strong and may handle a loaded wheelbarrow all day with ease.

Lung capacity.—This shows the greatest subnormality of all the measurements, only 8% of all feebleminded reaching the normal average. It is little connected with height or weight. It is so highly correlated with mental age (r = .64) that it alone could be taken as a fairly reliable index of mental defect. It is rather hard to apply, for the typical low-grade subjects are unaccountably timid in the experiment and often refuse to approach the instrument. The best of three trials was recorded in each case, but the pupil too often insisted on blowing through the nose, or on stopping the mouthpiece with his tongue.

Average.—None of these tests alone is a sure guide for diagnosis, but taken together they are, in Doll's opinion, of much value. Only 14% of feebleminded individuals come up to the normal average. Variability, however, is high. In individual diagnosis, considerations of race, nationality, heredity, environment, physiological development, health, exercise, physical defects, and special personal history must never be omitted.

One naturally wants to know whether the child is feebleminded because of his physical defects, or whether he is physically defective because he is feebleminded. But this question cannot be definitely answered, from the knowledge now available. Probably defects of both mind and body are due to very complicated processes of development involving the internal secretions, and neither is to be looked upon as the actual cause of the other. Doll takes pains not to express an opinion on this point, and to warn readers that his study is to be looked on only as preliminary, and intended only to supplement, not to supplant, the customary mental tests, in diagnosing feeblemindedness.

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[2] The normal accomplishment of boys and girls of various ages, in these six tests, is shown in Smedley's percentile tables. These have long been out of print, and the Training School has done a service by republishing them as an appendix to the present monograph.

THE ESSENCE OF MENDELISM

JOHN BELLING, *Washington, D. C.*

MENDEL discovered the facts relating to the progeny of hybrids in rather complex cases. His method of exposition, beginning with more or less complex examples, has been followed to some extent in most text-books. But it is an advantage for the student to begin with the simplest case, as is shown below.

1. If we cross a purple-flowered pea with a white-flowered one, both belonging to true-breeding races, all the progeny (hybrids) no matter which way we make the cross, have purple flowers.

2. When we fertilize the white-flowered parent with hybrid pollen, on the average half the progeny have purple flowers and half have white flowers. Hence only half the hybrid pollen-grains carry something which makes the purple color appear.

3. When we fertilize the hybrid with pollen from the white-flowered plant, we get again on the average half purple and half white-flowered plants. Hence half the egg-cells of the hybrid carry something which makes the purple appear.

4. In cases 2 and 3 the purple progeny are found, as we would expect, to be all hybrids, *i. e.*, they are not constant in their own progeny but give both purple- and white-flowered plants.

5. When we cross a purple-flowering pea with green pods with a white-flowering pea with yellow pods, all the hybrids have purple flowers and green pods.

6. When we fertilize the white-flowered plant with hybrid pollen we get, on the average, plants in these proportions:

¼ purple flowers and green pods.
¼ purple flowers and yellow pods.
¼ white flowers and green pods.
¼ white flowers and yellow pods.

Hence, one-fourth of the hybrid pollen grains carry something (which we call for convenience a *factor*) for purple and green, one-fourth factors for purple and yellow, one-fourth factors for white and green and one-fourth factors for white and yellow. This is shown by testing the self-fertilized progenies, when it is found that all purples or greens are inconstant (hybrid), while all whites and yellows are constant. It follows: (*a*) that the factors for purple flower and white flower are independent of the factors for green pod and yellow pod; and (*b*) that it is the combination of *factors* which are hybrid, and *not the whole plant*.

Generally, if A, B, C, D, E, . . . etc., are symbols for n independent *dominant* factors (which show in the hybrid) and a, b, c, d, e, . . . etc., are symbols for the corresponding *recessive* factors in a second plant, then on crossing the hybrids and the recessive parent we get 2^n different combinations in equal numbers on the average, showing that the hybrids have 2^n different kinds of pollen-grains and egg-cells.

Thus the hybrid $AaBbCcDd$, crossed with the recessive $a_2b_2c_2d_2$ gives, on the average:

1/16 $AaBbCcDd$
1/16 $AaBbCcd_2$
1/16 $AaBbc_2Dd$
1/16 Aab_2CcDd
1/16 $a_2BbCcDd$
1/16 a_2b_2CcDd
1/16 a_2Bbc_2Dd
1/16 a_2BbCcd_2
1/16 Aab_2c_2Dd
1/16 Aab_2Ccd_2
1/16 $AaBbc_2d_2$
1/16 $a_2b_2c_2Dd$
1/16 $a_2b_2Ccd_2$
1/16 $a_2Bbc_2d_2$
1/16 $Aab_2c_2d_2$
1/16 $a_2b_2c_2d_2$

7. If we were to fertilize a hybrid plant with its own pollen, it is readily seen that the result would be the same, as regards one pair of factors, as if we used equal amounts of the pollen of its two parents. One-quarter of the progeny would be constant dominant, one-quarter constant recessive, and one-half hybrid. Similarly, the complicated formulas given by Mendel for two or more pairs of factors can be deduced without further experiment.

Genetics Literature

THE annual reports of the AMERICAN BREEDERS' ASSOCIATION, published in seven volumes, form the most valuable collection of material for students of genetics which has been published in the United States. Most of them are out of print and are becoming expensive. All of them are nearly indispensable to libraries, institutions and students of plant and animal breeding, heredity, variation, eugenics, or genetics in general.

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